86TH CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
1st Session } { No. 1177

AMENDING SECTION 1 OF THE ACT OF JUNE 14, 1926, AS AMENDED BY THE ACT OF JUNE 4, 1954 (68 Stat. 173; 43 U.S.C. 869)

SEPTEMBER 11, 1959.—Ordered to be printed

Mr. ASPINALL, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany S. 1436]

The committee of conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1436) to amend section 1 of the act of June 14, 1926, as amended by the act of June 4, 1954 (68 Stat. 173; 43 U.S.C. 869), having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the Senate recede from its disagreement to the amendment of the House to the text of the bill, and agree to the same with an amendment as follows:

In lieu of the language inserted by the House amendment insert the following: *That subsection (b) of section 1 of the Act of June 14, 1926, as amended by the Act of June 4, 1954 (68 Stat. 173, 174; 43 U.S.C. 869), is further amended to read as follows:*

"(b) Conveyances made in any one calendar year shall be limited as follows:

"(i) For recreational purposes:

"(A) To any State, for not more than three sites, six thousand four hundred acres in all, except that during each of the calendar years 1960, 1961 and 1962, conveyances may be made for not more than six sites, comprising a total of not more than twelve thousand eight hundred acres and, in addition thereto, such acreage as may be needed for small roadside parks and rest sites of not more than ten acres each.

"(B) To any political subdivision of a State, six hundred and forty acres.

"(C) To any nonprofit corporation or nonprofit association, six hundred and forty acres.

"(ii) For public purposes other than recreation:

"(A) To any State or agency or instrumentality thereof, for any one program, six hundred and forty acres.

"(B) To any political subdivision of a State, six hundred and forty acres.

"(C) To any nonprofit corporation or nonprofit association, six hundred and forty acres."

SEC. 2. The last sentence of section 3 of the Act of June 14, 1926, as amended, is repealed.

And the House agree to the same.

That the Senate recede from its disagreement to the amendment of the House to the title of the bill, and agree to the same.

WAYNE N. ASPINALL,
GRACIE PFOST,
J. T. RUTHERFORD,
JOHN P. SAYLOR,
J. EDGAR CHENOWETH,
Managers on the Part of the House.

FRANK E. MOSS,
GORDON ALLOTT,
ERNEST GRUENING,
Managers on the Part of the Senate.

STATEMENT OF THE MANAGERS ON THE PART OF THE HOUSE

The managers on the part of the House at the conference on the disagreeing votes of the two Houses on the amendments of the House to the bill (S. 1436) to amend section 1 of the act of June 14, 1926, as amended by the act of June 4, 1954 (68 Stat. 173; 43 U.S.C. 869), submit the following statement in explanation of the effect of the action agreed upon and recommended in the accompanying conference report as to each of such amendments, namely:

There were three substantial differences between the bill as it passed the Senate and as it passed the House:

(1) The number of sites and the acreage that could be conveyed to any one State in any one year for recreational purposes were unlimited in the Senate version. In the House version, the number of sites was limited to three and the overall area to 6,400 acres.

(2) The acreage that could be conveyed in any one calendar year to any nonprofit corporation or nonprofit association for public purposes other than recreation was not covered in the House version; it was limited to 640 acres in the Senate language.

(3) The House version repealed a portion of the basic law limiting to 25 years the effectiveness of its reverter provisions. The Senate version did not do so.

The language recommended by the committee of conference disposes of these differences thus:

(1) It retains the three-site, 6,400-acre limitations of the House as a general proposition but permits a doubling of these figures for the calendar years 1960, 1961, and 1962. It also permits the conveyance, during these same years, of such additional acreage as may be needed for small roadside parks and rest sites of not more than 10 acres each.

(2) It limits the acreage that may be conveyed in any one calendar year to a nonprofit corporation or nonprofit association for public purposes other than recreation to 640 acres as in the Senate version of the bill.

(3) It repeals, as proposed in the House version, the 25-year limitation on reverters and thus makes effective in perpetuity other provisions of the basic law which forbid unauthorized transfers of the conveyed property or its conversion to unauthorized uses.

The language recommended by the committee of conference also omits the reference to "territories" contained in the House-passed language, in view of the fact that, since Alaska has become a State, there is no territory of the United States to which the basic act, which deals only with public domain and certain lands reserved therefrom, is applicable.

WAYNE N. ASPINALL,
GRACIE PFOST,
J. T. RUTHERFORD,
JOHN P. SAYLOR,
J. EDGAR CHENOWETH,
Managers on the Part of the House.

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86TH CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
1st Session } { No. 1178

EXTENSION AND AMENDMENT OF PUBLIC LAW 480

SEPTEMBER 11, 1959.—Ordered to be printed

Mr. GRANT, from the committee of conference, submitted the following

CONFERENCE REPORT

[To accompany H.R. 8609]

The committee of conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 8609) to amend the Agricultural Trade Development and Assistance Act of 1954, as amended, by extending the authorities of titles I and II, strengthening the program of disposals through barter, and for other purposes, having met, after full and free conference, have agreed to recommend and do recommend to their respective Houses as follows:

That the House recede from its disagreement to the amendment of the Senate and agree to the same with an amendment as follows:

In lieu of the matter proposed to be inserted by the Senate amendment insert the following:

TITLE I—AMENDMENTS TO THE AGRICULTURAL TRADE DEVELOPMENT AND ASSISTANCE ACT OF 1954

SECTION 1. Sections 109 and 204 of the Agricultural Trade Development and Assistance Act of 1954, as amended, are amended by striking out "1959" and substituting in lieu thereof "1961".

SEC. 2. Section 103(b) of such Act is amended, effective January 1, 1960, to read as follows:

"(b) Agreements shall not be entered into under this title in any calendar year during the period beginning January 1, 1960, and ending December 31, 1961, which will call for appropriations to reimburse the Commodity Credit Corporation, pursuant to subsection (a) of this section, in amounts in excess of $1,500,000,000, plus any amount by which agreements entered into in the preceding calendar year have called or will call for appropriations to reimburse the Commodity Credit Corporation in amounts less than authorized for such preceding year by this Act as in effect during such preceding year."

SEC. 3. Section 203 of such Act is amended, effective January 1, 1960, by striking out the first sentence and inserting in lieu thereof:

"Not more than $300,000,000 (including the Corporation's investment in such commodities) plus any amount by which transfers made in the preceding calendar year have called or will call for appropriations to reimburse the Commodity Credit Corporation in amounts less than could have been expended during such preceding year under this title as in effect during such preceding year shall be expended in any calendar year during the period January 1, 1960, and ending December 31, 1961, for all such transfers and for other costs authorized by this title."

SEC. 4. Subsection (a) of section 104 of such Act is amended by inserting a period in lieu of the semicolon at the end thereof, and adding the following:

"From sale proceeds and loan repayments under this title not less than the equivalent of 5 per centum of the total sales made under this title after the date of this amendment shall be made available in advance for use as provided by this subsection over such period of years as the Secretary of Agriculture determines will most effectively carry out the purpose of this subsection: Provided, That no such funds shall be allocated under this subsection after June 30, 1960, except as may be specified, from time to time, in appropriation acts. Particular regard shall be given to provide in sale and loan agreements for the convertibility of such amount of the proceeds thereof as may be needed to carry out the purpose of this subsection in those countries which are or offer reasonable potential of becoming dollar markets for United States agricultural commodities. Notwithstanding any other provision of law, if sufficient foreign currencies for carrying out the purpose of this subsection in such countries are not otherwise available, agreements may be entered into with such countries for the sale of surplus agricultural commodities in such amounts as the Secretary of Agriculture determines to be adequate and for the use of the proceeds to carry out the purpose of this subsection;"

SEC. 5. Subsection (b) of section 104 of such Act is amended to read as follows:

"(b) To purchase or contract to purchase, in such amounts as may be specified from time to time in appropriation acts, strategic or other materials for a supplemental United States stockpile of such materials as the President may determine from time to time. Such strategic or other materials acquired under this subsection shall be placed in the above named supplemental stockpile and shall be released therefrom only under the provisions of section 3 of the Strategic snd Critical Materials Stock Piling Act;"

SEC. 6. Section 104(k) of such Act is amended by striking out the colon and inserting in lieu thereof a comma and the following: "and to promote and support programs of medical and scientific research, cultural and educational development, health, nutrition, and sanitation:".

SEC. 7. Section 104(o) of such Act is amended by striking out so much thereof as follows the semicolon.

SEC. 8. Section 104 of such Act is further amended by inserting after paragraph (o) the following new paragraphs:

"(p) For supporting workshops in American studies or American educational techniques and supporting chairs in American studies;

"(q) For assistance to meet emergency or extraordinary relief requirements other than requirements for surplus food commodities: Provided,

That not more than a total amount equivalent to $5,000,000 may be made available for this purpose during any fiscal year;

"(r) For financing the preparation, distribution, and exhibiting of audio-visual informational and educational materials, including Government materials, abroad: Provided, That not more than a total amount equivalent to $2,500,000 may be made available for this purpose during any fiscal year, but nothing in this subsection shall limit or affect the use of foreign currencies to finance the preparation, distribution, or exhibition of such materials in connection with trade fairs and other market development activities under subsection (a);".

SEC. 9. Section 104 of such Act is further amended by inserting before the period at the end thereof a colon and the following: "Provided, however, That no foreign currencies shall be available for the purpose of subsection (p), except in such amounts as may be specified from time to time in appropriation Acts, and no foreign currencies shall be allocated under any provision of this Act after June 30, 1960 for the purposes specified in subsections (k), (p), and (r), except in such amounts as may be specified from time to time in appropriation Acts".

SEC. 10. Section 305 of such Act is amended to read as follows:

"SEC. 305. All Commodity Credit Corporation stocks donated abroad under title II of this Act and section 416 of the Agricultural Act of 1949, as amended, shall be clearly identified by appropriate marking on each package or container and insofar as practical in the language of the locality where such stocks are distributed as being furnished by the people of the United States of America and where available funds accruing under title I shall be used for this purpose."

SEC. 11. Title III of such Act is amended by adding at the end thereof the following new section:

"SEC. 306. (a) In order to promote the general welfare, raise the levels of health and of nourishment for persons whose incomes prevent them from enjoying adequate diets, and dispose in a beneficial manner of food commodities acquired by the Commodity Credit Corporation or the Department of Agriculture in carrying out price support operations or diverted from the normal channels of trade and commerce under section 32 of the Act of August 24, 1935, as amended, the Secretary of Agriculture (in this section referred to as the 'Secretary') is hereby authorized to promulgate and put into operation a program to distribute to needy persons in the United States, including needy Indians, through a food stamp system such surplus food commodities. Such program shall provide for the distribution of such surplus food commodities only during the period beginning February 1, 1960 and ending January 31, 1962. The cost of such program, including the cost to the Federal Government of acquiring, storing, and handling such surplus food commodities, shall not exceed $250,000,000 in any 12-month period beginning February 1 and ending January 31.

"(b) In carrying out such program, the Secretary shall—

"(1) distribute surplus food made available by the Secretary for distribution under this program only when requested to do so by a State or political subdivision thereof;

"(2) issue, or cause to be issued, pursuant to subsection (c), food stamps redeemable by eligible needy persons for such types and quantities of surplus food as the Secretary shall determine;

"(3) distribute surplus food in commercially packaged form, preferably through normal channels of trade;

"(4) establish standards under which, pursuant to subsection (c), the welfare authorities of any State or political subdivision thereof may participate in the food stamp plan for the distribution of surplus foods to the needy;

"(5) consult the Secretary of Health, Education, and Welfare, and the Secretary of Labor, in establishing standards for eligibility for surplus foods and in the conduct of the program generally to assure achievement of the goals outlined in subsection (a) of this section; and

"(6) make such other rules and regulations as he may deem necessary to carry out the purpose of this section.

"(c) The Secretary shall issue, to each welfare department or equivalent agency of a State or political subdivision requesting the distribution of surplus food under subsection (b)(1), food stamps for each kind of surplus food to be distributed, in amounts based on the total amount of surplus food to be distributed and on the total number of needy persons in the various States and political subdivisions eligible to receive such food. The food stamps shall be issued by each such welfare department or equivalent agency to needy persons receiving welfare assistance, or in need of welfare assistance but ineligible because of State or local law, and shall be redeemable by such needy persons at local distribution points to be determined by the Secretary under subsection (b)(3).

"(d) Receipt by any person of benefits under this section shall not be deemed to be income or resources under the provisions of the Social Security Act or any other Federal legislation pertaining to the security of the aged, blind, disabled, dependent children, unemployed, or other similar groups. Any State or local subdivision thereof which decreases the cash or other assistance extended to any person or group as a consequence of the assistance made available under this section shall be ineligible for further participation under this section.

"(e) Surplus foods to be distributed under this section shall be limited to surplus foods acquired under the Agricultural Act of 1949 or diverted from the normal channels of trade under section 32 of Public Law 320, Seventy-fourth Congress.

"(f) For the purposes of this section, a needy person is anyone receiving welfare assistance (financial or otherwise) from the welfare department or equivalent agency of any State or political subdivision thereof, or who is, in the opinion of such agency or agencies, in need of welfare assistance but is ineligible to receive it because of State or local law.

"(g) The Secretary of Agriculture, in consultation with the Secretary of Health, Education, and Welfare and the Secretary of Labor, shall make a study of, and shall report to Congress within six months after the date of enactment of this section, on the feasibility of, the costs of, and the problems involved in, extending the scope of the food stamp plan established by this section to include persons receiving unemployment compensation, receiving old-age and survivors insurance (social security) pensions, and other low-income groups not eligible to receive food stamps under this section.

"(h) There are hereby authorized to be appropriated, out of any money in the Treasury not otherwise appropriated, such sums as may be necessary to carry out the purposes of this section."

SEC. 12. Title III of such Act is further amended by adding at the end thereof a new section as follows:

"SEC. 307. Whenever the Secretary of Agriculture determines under section 106 of this Act that any food commodity is a surplus agricultural commodity, insofar as practicable he shall make such commodity available for distribution to needy families and persons in the United States in such quantities as he determines are reasonably necessary before such commodity is made available for sale for foreign currencies under title I of this Act."

SEC. 13. Title III of such Act is further amended by adding at the end thereof a new section as follows:

"SEC. 308. Notwithstanding any other provision of law, the Commodity Credit Corporation is hereby authorized—

"(1) to dispose of its stocks of animal fats and edible oils or products thereof by donation, upon such terms and conditions as the Secretary of Agriculture deems appropriate, to nonprofit voluntary agencies registered with the Department of State, appropriate agencies of the Federal Government or international organizations, for use in the assistance of needy persons outside the United States;

"(2) to purchase for donation as provided above such quantities of animal fats and edible oils and the products thereof as the Secretary determines will tend to maintain the support level for cottonseed and soybeans without requiring the acquisition of such commodities under the price support program.

Commodity Credit Corporation may incur such additional costs with respect to commodities to be donated hereunder as it is authorized to incur with respect to food commodities disposed of under section 416 of the Agricultural Act of 1949, and may pay ocean freight charges from United States ports to designated ports of entry abroad."

SEC. 14. Such Act is further amended by adding thereto the following new title:

"TITLE IV—LONG-TERM SUPPLY CONTRACTS

"SEC. 401. The purpose of this title is to utilize surplus agricultural commodities and the products thereof produced in the United States to assist the economic development of friendly nations by providing long-term credit for purchases of surplus agricultural commodities for domestic consumption during periods of economic development so that the resources and manpower of such nations may be utilized more effectively for industrial and other domestic economic development without jeopardizing meanwhile adequate supplies of agricultural commodities for domestic use.

"SEC. 402. In furtherance of this purpose, the President is authorized to enter into agreements with friendly nations under which the United States shall undertake to provide for delivery annually of certain quantities of such surplus agricultural commodities for periods of not to exceed ten years, pursuant to the terms and conditions set out in this title, providing such commodities are in surplus at the time delivery is to be made.

"SEC. 403. Payment for such commodities shall be in dollars with interest at such rate as the Secretary may determine but not more than the cost of the funds to the United States Treasury as determined by the Secretary of the Treasury, taking into consideration the current average market yields on outstanding marketable obligations of the United States having maturity comparable to the maturities of loans made by the President under this section. Payment may be made in approximately equal annual amounts over periods of not to exceed twenty years from the date

of the last delivery of commodities in each calendar year under the agreement and interest shall be computed from the date of such last delivery.

"SEC. 404. In carrying out the provisions of this title, the Secretary of Agriculture shall endeavor to maximize the sale of United States agricultural commodities taking such reasonable precautions as he determines necessary to avoid replacing any sales which the Secretary finds and determines would otherwise be made for cash dollars.

"SEC. 405. In entering into such agreements, the Secretary shall endeavor to reach agreement with other exporting nations of such commodities for their participation in the supply and assistance program herein authorized on a proportionate and equitable basis.

"SEC. 406. In carrying out this title, the provisions of sections 102, 103(a), 106, 107, and 108 of this Act shall be applicable to the extent not inconsistent with this title."

TITLE II—MISCELLANEOUS

SEC. 201. (a) In order to insure the nutritional value of cornmeal, grits, and white flour when such foods are made available for distribution under section 416(3) of the Agricultural Act of 1949 or for distribution to schools under the National School Lunch Act or any other Act, such foods shall be enriched so as to meet the standards for enriched cornmeal, enriched corn grits, or enriched flour, as the case may be, prescribed in regulations promulgated under the Federal Food, Drug, and Cosmetic Act; and in order to protect the nutritional value and sanitary quality of such enriched foods during transportation and storage such foods shall be packaged in sanitary containers. For convenience and ease in handling, the weight of any sanitary container when filled shall not exceed fifty pounds.

(b) The term "sanitary container" means any container of such material and construction as (1) will not permit the infiltration of foreign matter into the contents of such container under ordinary conditions of shipping and handling, and (2) will not, for a period of at least one year, disintegrate so as to contaminate the contents of the container, necessitating the washing of the contents prior to use.

SEC. 202. In lieu of the limitation on annual payment rates for 1960 conservation reserve contracts prescribed in clause (2) of the sixth proviso under the head "Conservation Reserve" in Public Law 86-80, no such annual payment rate shall be established in excess of 20 per centum of the value of the land placed under contract, such value to be determined without regard to physical improvements thereon or geographical location thereof; but in no event shall such annual payment rate be established in excess of the maximum rate which the county committee determines would have been established for such land under the 1959 Conservation Reserve Program, except that the county committee in making such determination shall not be required to obtain the landowner's or operator's estimate as to value or his certificate as to production history and productivity.

SEC. 203. Section 347(b) of the Agricultural Adjustment Act of 1938, as amended, is amended by striking out the period at the end thereof and inserting a colon and the following: "Provided, however, That the national marketing quota for the 1960 crop of such cotton shall be not less than 90 per centum of the 1959 marketing quota for such cotton."

SEC. 204. Section 206(a) of the Agricultural Act of 1956 is amended by inserting before the period at the end thereof a comma and the following: "or to meet requirements of Government agencies".

And the Senate agree to the same.

That the House recede from its disagreement to the amendment of the Senate to the title of the bill and agree to the same.

GEORGE M. GRANT,
E. C. GATHINGS,
CARL ALBERT,
CLARK W. THOMPSON,
CHARLES B. HOEVEN,
PAGE BELCHER,
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Managers on the Part of the Senate.

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STATEMENT OF MANAGERS ON THE PART OF THE HOUSE

The managers on the part of the House at the conference on the disagreeing votes of the two Houses on the amendment of the Senate to the bill (H.R. 8609) to amend the Agricultural Trade Development and Assistance Act of 1954, as amended, by extending the authorities of titles I and II, strengthening the program of disposal through barter, and for other purposes, submit the following statement in explanation of the effect of the action agreed upon and recommended in the accompanying conference report:

The Senate amendment struck out all after the enacting clause of H.R. 8609 and substituted new language. The House bill contained numerous provisions not included in the Senate amendment and the Senate amendment contained numerous provisions new to the House bill. In lieu of the Senate amendment, the conferees have agreed upon an amendment combining many of the provisions of both bills. Following are the substantive differences between the conference bill herewith reported and H.R. 8609 as it passed the House.

EXTENSION OF PUBLIC LAW 480

The House bill extended titles I and II of the act for 1 year (from December 31, 1959) with an additional authorization of $1.5 billion for title I and $300 million for title II. The Senate amendment extended both titles for 3 years with additional authorizations at the same rate per year as provided in the House bill. The conferees have compromised on a 2-year extension of titles I and II with increased authorizations at the rate provided in both the House bill and the Senate amendment—$1.5 billion per year for title I and $300 million per year for title II.

FOOD STAMP PLAN

The provisions relating to distribution of surplus foods in the United States through a food-stamp plan follow generally the language of the House bill, with the following substantive changes:

(1) Duration of the authority is limited to 2 years starting February 1, 1960; (2) foods to be distributed are clearly limited to surplus foods acquired under the Agricultural Act of 1949 or diverted from normal channels of trade under section 32 of Public Law 320, 74th Congress; (3) the maximum which may be spent in any 12-month period is placed at $250 million, based on the cost to the Federal Government of acquiring, storing, and handling such food; (4) adopted Senate language providing that receipt by any person of benefits under the program should not be deemed income or resources under the provisions of the Social Security Act or related Federal legislation and providing that any State or local subdivision thereof which decreases the cash or other assistance extended to any person because of assistance under the food-stamp program should not be eligible for further participation in such program.

The conferees note that although the language of the amendment agreed upon is permissive as in the House bill, legislation authorizing and directing food-stamp programs was passed by the Senate. It is the expectation of the conferees that the Secretary at his discretion will undertake such a program along the lines laid down in the conference report.

In making regulations the Secretary should include the Bureau of Indian Affairs and/or tribal councils designated by the Bureau of Indian Affairs as "welfare agencies" as he has done in the past with respect to the Department of Agriculture's program of donation of food commodities for relief purposes.

USE OF FOREIGN CURRENCIES FOR RELIEF PURPOSES

Section 7 of the House bill provided that not to exceed $2 million in local currencies might be used each year in each country for emergency relief requirements. The Senate amendment contained a similar provision but limited the total amount to $2 million of foreign currencies per year. The conference substitute has amended this provision to permit up to $5 million of foreign currencies to be spent each year for this purpose.

LONG-TERM SUPPLY CONTRACTS

The conference substitute retains the House provision authorizing long-term supply contracts to be entered into on dollar credit. It adopted a clarifying amendment to make it clear that the supply contracts are to relate only to surplus commodities. In agreeing to retain this provision, the conferees note that it is not the intent of section 405 of this new title to require continuing consultation with other countries on the program, but merely to give other interested countries an opportunity to enter into a participating agreement if they so desire. For example, the conferees are aware that negotiations are now going on with other countries under the food-for-peace program and assume that this new program will be discussed with them at an early date as part of these negotiations.

HOUSE PROVISIONS RETAINED

The following provisions of the House bill are retained in the conference substitute without any change other than perfecting or clarifying amendment:

Section 3, requiring the earmarking of 5 percent of foreign currencies accruing under title I for market development purposes.

Section 4, authorizing purchase with foreign currency of materials other than those required for the national stockpile.

Section 13, requiring that insofar as practical surplus commodities donated abroad shall be marked in the language of the locality where they are distributed as being furnished by the people of the United States.

Section 16, providing that materials currently required by the Department of Defense, the Atomic Energy Commission, and other Government agencies may be acquired through barter.

Section 17, providing that the national marketing quota for the 1960 crop of long staple cotton shall not be less than 90 percent of the 1959 marketing quota.

ELIMINATED FROM HOUSE BILL

The substitute amendment herewith reported does not contain the following provisions which were in the bill as passed by the House:

Section 5, providing that payments received from loans made under the "Cooley amendment" would be retained by the Export-Import Bank for the making of additional such loans.

Section 6, requiring that loans of foreign currencies made to foreign countries for economic development should have a "maintenance of value" provisions requiring repayment in foreign currencies equivalent to the dollar value of the payment at the time each payment is made.

Section 8, authorizing the establishment in foreign countries of food reserves under the authority of title I of Public Law 480.

Section 9, authorizing the donation of surplus agricultural commodities under title II of the act "in order to promote economic development" in underdeveloped areas.

Section 10, authorizing the payment of "charges for general average contributions" out of foreign currencies accruing under title I.

Section 12, providing that the Secretary should permit and encourage barter for materials processed in the United States if the agricultural commodities to be bartered for such materials are exported to friendly foreign countries.

Section 18, providing that this act might be cited as the "Food for Peace Act of 1959."

PROVISIONS ADDED TO HOUSE BILL

The following substantive provisions of the conference substitute did not appear in the bill as passed by the House:

Specifically provides for the use of foreign currencies for (*a*) programs of medical and scientific research and development, (*b*) workshops in American studies or American educational techniques and supporting chairs in American studies (these two are not new uses but are specific restatement of authority existing in the act), and (*c*) for the preparation, distribution, and exhibiting of audio-visual informational and educational material up to $2.5 million per year; and provides that the appropriating process shall apply to all of the local currency uses so designated.

A provision that whenever the Secretary of Agriculture determines that any food commodity is a surplus commodity for purposes of sale under title I of the act, he shall, insofar as practicable, make such commodity available for domestic relief distribution. The phrase "insofar as practicable" would give the Secretary latitude to sell for foreign currencies without making commodities available for relief distribution in the United States in certain circumstances. For example, where the quantity involved is insufficient for effective distribution to needy families in the United States, where the perishable nature of the commodity makes such distribution impractical, or where it is desirable to sell a limited quantity for market development purposes.

A provision authorizing disposition of CCC stocks of animal fats and edible oils (or products) for use in assistance of needy persons outside the United States. The section also authorizes such purchase of such fats, oils, and products as will tend to maintain the support level for cottonseed and soybeans.

A section which requires that cornmeal, grits, and white flour distributed under section 416(3) of the Agricultural Act of 1949, or to schools, be enriched and packaged in sanitary containers not exceeding 50 pounds each.

A section providing, in essence, for the same limitation on rental payments for contracts entered into in the 1960 conservation reserve program as applied in 1959, i.e., 20 percent of the value of the land without regard to improvements or location. This would replace the limitation prescribed for 1960 contracts by the 1960 Agriculture Appropriation Act, i.e., the fair rental value based on past 5-year crop production. The section also provides that the 1960 payment rate cannot exceed what would have been established for 1959.

GEORGE M. GRANT,
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Managers on the Part of the House.

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Union Calendar No. 509
86th Congress, 1st Session - - - - - - House Report No. 1179

DISSEMINATION OF SCIENTIFIC INFORMATION

REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS
U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS
FIRST SESSION

[No. 27]

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

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LETTER OF SUBMITTAL

COMMITTEE ON SCIENCE AND ASTRONAUTICS,
HOUSE OF REPRESENTATIVES,
Washington, D.C., September 8, 1959.

Hon. SAM RAYBURN,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the enclosed report, "Scientific Manpower and Education."

The report is based upon hearings before the full committee, and incorporates a committee resolution concerned with the immediate problems of keeping track of the Nation's scientific and technical personnel.

The findings and recommendations herein are, therefore, earnestly offered to the 86th Congress for consideration.

OVERTON BROOKS, *Chairman.*

LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., August 11, 1959.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report on "Dissemination of Scientific Information" prepared by Lt. Col. Paul B. Schuppener, staff consultant, and John A. Carstarphen, Jr., counsel.

This report is based on testimony provided by knowledgeable witnesses representing Government agencies, private research libraries and technical information services of private industry. The problem of dissemination of scientific information together with the translation of foreign scientific documents is of ever-increasing importance in view of the rapidity with which present-day technological changes occur. It is felt that this report and the hearings upon which it is based will in some measure aid the seeking scientists and other interested parties to find further means of securing available information in fields in which they are interested.

CHARLES F. DUCANDER,
Executive Director and Chief Counsel.

Union Calendar No. 509

86TH CONGRESS, 1st Session } HOUSE OF REPRESENTATIVES { REPORT No. 1179

DISSEMINATION OF SCIENTIFIC INFORMATION

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. BROOKS of Louisiana, from the Committee on Science and Astronautics, submitted the following

REPORT

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DISSEMINATION OF SCIENTIFIC INFORMATION

INTRODUCTION

"This year the U.S. Government will spend over $5 billion on research, engineering and development, substantially more than it spent in the entire four decades 1900–1939—and more than the total Federal budget of a generation ago."

This statement, contained in the December 1958 report entitled "Strengthening American Science" and issued by the President's Science Advisory Committee, is indicative of the tremendous importance and cost of research and development activities, and it implies a rapidly expanding scope of scientific knowledge. Five billion dollars represents approximately half of the cost of the total research, engineering and development activities being carried on throughout the United States. The balance is supported by industry, by universities and by private research foundations.

Basic research, which has been defined as the search for new knowledge and understanding, is the foundation upon which applied research, engineering and development effort is based. Without new basic knowledge we cannot make new progress in the design and construction of useful articles. And yet, only a small portion of the Government's total research and development budget is actually applied to basic research. Again quoting from the report of the President's Science Advisory Committee:

> Of the Government's total research and development budget, it is estimated that about 6 percent is earmarked for basic research. The remainder pays for applied research and the development of an almost endless list of "things"—such as ballistic missiles, jet planes, satellites, nuclear reactors, insecticides, vaccines, dru gs, computers, rocket fuels, and space suits. Especially since the Korean war, the money available to develop "things" has risen far more swiftly than the money available for basic research.
>
> Also undernourished, along with basic research, is "analytical engineering" or applied or supporting research—the sophisticated scrutiny of available knowledge to determine what sort of things are possible to build, or to invent (if need be) and which are not, and what may be the magnitude of their cost.

These quotations show that there is a tremendous need for basic research information and that while there is a great deal of money and effort going into research and development efforts, most is going into development.

The National Science Foundation, in a publication entitled "Information for Scientists," took note of the accelerated use of fundamental scientific knowledge and stated as follows:

> The consumption of fundamental science by the technologies is increasing at a very rapid rate. Where formerly the timelag between the development of a fundamental idea and its utilization by technology was measured in tens of years, it is now measured in months and weeks. Within weeks after the development of the decay scheme of thorium, for instance, plans were developed to build reactors to utilize this discovery.
>
> There is more time lost—and therefore, more time to be gained—between the laboratory and the drawing board than there is between the drawing board and the production line. And it is in the former period, where ideas rather than physical materials are involved, that speedup is most feasible. Ideas have no inertia; their occurrence can be accelerated indefinitely—subject only to the limits of our skill and facilities for information processing.

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The less time scientists need to spend in searching out what is already known, the more time they can spend actively on research. Thus, improvements in scientific information facilities will be reflected in improved utilization of scientists' time—in effect, this is equivalent to an increase in the number of available scientists. Quoting the President's Committee on Scientists and Engineers, "A 10 percent improvement in the utilization of scientists and engineers would be equivalent to a 10 percent increase in the supply."

On the basis of what has been said so far one might reach the conclusion that increased basic and supporting research and the improvement of scientific information facilities are required to maintain the tremendous development effort. This is true to a degree, but greatly increased research effort without full knowledge of the work of others may be wasteful of time and damaging to the scientist's reputation if his work proves to lack originality. Perhaps the most important step that can be taken is to insure that basic research knowledge which has been generated throughout the world is made available promptly, accurately and easily to our American scientists and engineers. Many people would say that this is a difficult task because surely the Russians, for example, would not share their knowledge with us. But this is not necessarily true. Basic research knowledge is not patentable, it does not involve proprietary rights, and since it is obvious that basic research knowledge does not lead directly to the development of military weapons, there is less directed secrecy. Instead, there is enthusiam among most members of the "scientific community", that is, scientists the world over, to share this kind of information with one another, to query one another on their individual experiences, and to seek verification of research results. Under these circumstances, this most important segment of information that we want our American scientists and engineers to obtain is impeded primarily by such things as physical separation, language, lack of publication media, and sheer volume of material produced.

Of course we would also like to gain information on new processes and devices, but here the problems of patent rights, proprietary interests and military secrecy often intervene at least to slow the process of dissemination. Such information is not completely withheld even by foreign countries. In fact, there is probably but little more restriction on our gaining such information from abroad than from domestic sources.

In recognition of the great need for timely and effective exchange of scientific information and with the realization that a number of Government agencies shared the responsibility for dissemination of scientific information, certain provisions were written into the National Defense Education Act of 1958 (Public Law 85-864). Title IX—Science Information Service provides that—

The National Science Foundation shall establish a Science Information Service. The Foundation, through such Service, shall (1) provide, or arrange for the provision of, indexing, abstracting, translating, and other services leading to a more effective dissemination of scientific information, and (2) undertake programs to develop new or improved methods, including mechanized systems, for making scientific information available.

In addition, the act provides that a Science Information Council shall be established, consisting of the Librarian of Congress, the Director of the National Library of Medicine, the Director of the Department of Agriculture Library, the head of the Science Information Service, and 15 members to be appointed by the Director of the

National Science Foundation. Six of this latter group are to be leaders in the fields of fundamental science, six to be leaders in the field of librarianship and scientific documentation, and three to be outstanding representatives of the lay public who have demonstrated interest in the problems of communication. The act also provides a general authorization permitting the appropriation each fiscal year of funds required to carry out the provisions of the title.

It was with this background of concern over the problems of dissemination of scientific information and a desire to learn just how the Science Information Service of the National Science Foundation proposed to carry out its new responsibility that the Committee on Science and Astronautics initiated a series of hearings on this area of scientific effort. The following distinguished group of witnesses appeared before the full committee: G. Miles Conrad, president, National Federation of Science Abstracting and Indexing Services; Dr. Larkin H. Farinholt, Deputy Science Adviser, Department of State; John C. Green, Director of Technical Services, Department of Commerce; Dr. Herman H. Henkle, of the John Crerar Library, Chicago; Ben G. Huff, Director of Review and Services, Office of the Director of Defense Research and Engineering, OSD; William T. Knox, director of technical information division, Esso Research & Engineering Co.; Foster E. Mohrhardt, Director, U.S. Department of Agriculture Library (National Library of Agriculture); Dr. L. Quincy Mumford, Librarian of Congress; Dr. Frank B. Rogers, Director of the National Library of Medicine; and Dr. Alan T. Waterman, Director of the National Science Foundation. This report is intended to summarize the testimony provided and to make recommendations thereon.

COLLECTION

The first step in the overall effort of disseminating scientific information is the collection of books, monographs, and other documents. It is popularly assumed to be the most difficult task. But from the testimony given this committee, it appears that the problem is more one of making a judicious selection of available material rather than difficulty in acquisition. It is recognized, however, that publications in some countries are difficult to obtain because of government control or the small volume of publications.

The collection of scientific documents is essentially a library function. Three U.S. Government libraries—the Library of Congress, the National Library of Medicine, and the Department of Agriculture Library—may be viewed collectively as a single great national science library engaged in this function. Their efforts in their respective fields of science interest have proved highly successful.

The Library of Congress has been preeminent in this field since 1866 when by act of Congress the Smithsonian Institution's science collection was transferred to it. Since that time the science collection has grown steadily until as of June 30, 1958, there were more than 1,486,000 volumes comprising monographs and serials in the area of science and technology. The expansion continues through the materials drawn from a worldwide network of more than 17,000 exchange agreements with governments, private research centers, libraries, universities, and other scientific and technical institutions. These

sources provide annually nearly half a million books, pamphlets, journals, and other materials in printed, near print, and photographic copy form. It is interesting to note that in the Soviet Union alone there are 151 scientific and technological institutions which regularly exchange publications with the Library.

The Library of Congress has placed standing orders with some 750 book dealers throughout the world to provide publications of importance, regardless of language or country of origin. During the last fiscal year the Soviet Union provided through such orders nearly 57,000 pieces, and on exchange another 31,000 pieces in all fields of knowledge.

The Department of Agriculture Library had its beginning with the establishment of the Division of Chemistry, in 1862, and in the intervening years has assembled one of the world's most complete collections of books, reports, and journals. Contained in over a million volumes, this collection covers general and agricultural chemistry, botany, zoology, agricultural bacteriology, entomology, forestry, soils, agricultural engineering, veterinary medicine, and plant pathology. Like the Library of Congress, the Department of Agriculture Library has extensive agreements in its field of scientific interest and readily obtains publications from the U.S.S.R., Yugoslavia, and Poland, as examples of Iron Curtain countries. Of the foreign contributions, the Department of Agriculture Library is particularly interested in publications in the field of agriculture from the mainland of China. The Library has examined some 92 journals being published there and has chosen 50 which are now obtained by purchase in Hong Kong.

The National Library of Medicine, the third great science library in the United States, was founded in 1836, originally as the Library of the Surgeon General of the U.S. Army. It subsequently went through several name changes and in 1956, then known as the Armed Forces Medical Library, was transferred to the Public Health Service and renamed the National Library of Medicine. It also collects documents on a worldwide basis regardless of language, time, or place of publication, and has amassed over a million volumes on health and disease. During 1958 over 30,000 books were received and cataloged by the National Library of Medicine. During this same period 110,000 medical articles from the medical literature of the world were also added and indexed.

Other Government agencies are also active in the collection of scientific and technical documents—more, however, in areas of technological developments, devices, and processes than in the basic sciences. Government agencies actively engaged in collection activities within their fields of interest include the Atomic Energy Commission (AEC), the National Aeronautics and Space Administration (NASA), Central Intelligence Agency (CIA), and, as a central service for the Army, the Navy, the Air Force, and the Armed Services Technical Information Agency (ASTIA). These Government agencies function, too, on a worldwide basis for the collection of documents by purchase and exchange. Some of the information collected is in the form of technical reports prepared in connection with defense contracts and some is obtained by more or less covert methods. In many cases the information is classified because of military security or by reason of proprietary rights involvement. These agencies, then, are not designed to provide services to the general public. As

certain of the documents become releasable—normally after some period of time—they are transferred to the Library of Congress collection, and at the same time copies are forwarded directly to the Office of Technical Services in the Department of Commerce for dissemination to the public through listing and sale.

But the collection of scientific information does not stop with Government agencies. There are many contacts between individual scientists in this country and those in other countries of the world which serve as avenues for the exchange of ideas, research results, and published documents. Furthermore, there are many private organizations engaged in the collection, indexing, and abstracting of scientific documents. These include such organizations as Aeronautical Reviews, Applied Mechanics Reviews, Biological Abstracts, Chemical Abstracts, Engineering Index, Mathematical Reviews, Meteorological Abstracts, Psychological Abstracts, and Review of Metal Literature. These organizations frequently maintain contacts with their counterparts in other countries and they are sometimes able to obtain information that Government agencies may not under current rules. For example, a contact has been established with the Institute of Scientific Information, Academia Sinica, in Peking, China, which promises to result in the exchange of biological science abstracts published in this country for those published on the Chinese mainland.

Traditionally, individual scientists, scientific societies, scientific libraries, and institutions in the United States have served as agents for the international exchange of information. The Farmington plan is an example of this cooperative effort. Since 1948, the major research libraries of the country have been able under this plan to obtain maximum coverage on a worldwide basis of books and pamphlets of research interest. Participating libraries have agreed to accept responsibility, based on subject and country allocations, for the procurement of at least one copy of significant research literature. However, the Farmington plan was originally aimed at liberal arts materials and is weak in science and the production from Slavic areas.

The number of organizations, both in and out of Government, engaged in the collection of scientific documents and the volume of documents resulting from their efforts indicate that while we may have problems in other areas of dissemination of information, there is no real difficulty in the collection phase. In fact, Mr. William T. Knox, director of the technical information division, Esso Research & Engineering Co., in his appearance before the committee said:

> We feel it is very important to realize that the United States has no shortage of information, but a real shortage of people who are talented and trained and motivated to make use of this information.

INDEXING AND ABSTRACTING

The vast volume of scientific documents which become available as a result of a purposeful collection operation makes it necessary to have particularly skillful cataloging, indexing, and abstracting. This traditional library operation is not only highly technical, but is a time-consuming process. The Library of Congress prepares printed catalog cards, which are distributed to some 10,000 subscribers, and monthly lists, such as New Serial Titles (listing the periodicals which the Library and some 200 other libraries receive), the Monthly Index of Russian Accessions, the East European Accessions Index, and the Southern Asia Accessions List.

The Department of Agriculture Library lists its current resources through a monthly publication entitled The Bibliography of Agriculture. The National Library of Medicine publishes and sells through the Library of Congress an annual catalog of books on medicine. The Library of Medicine also publishes monthly the Current List of Medical Literature.

The Office of Technical Services in the Department of Commerce has a semimonthly publication, Technical Translations, which lists all those items of translated technical literature available from the Department of Commerce, Library of Congress, the Special Libraries Association, cooperating foreign governments, commercial translators, and other sources. Because the OTS is required to be self-supporting, it is highly selective in what it makes available for general use.

The Central Intelligence Agency assembles, and the Department of Commerce distributes, a semimonthly publication known as Scientific Information Report, which provides a listing and the abstracts of many publications of the U.S.S.R., Eastern Europe, and China, in fields of basic science. These and the many listings prepared by individual indexing and abstracting organizations make up a tremendous effort in this area.

TRANSLATION

Every phase in the process of dissemination of scientific information necessarily results in a weeding out of some publications as the next most time-consuming phase must be undertaken. So initially, we collect only those documents in which we think we have real interest. As the cataloging, indexing, and abstracting phase is entered, many are discarded. But the translating phase is even more time consuming and places more stringent requirements on specialized skills and knowledge. As a result, of all the foreign publications received, only a few of the more important are translated on a cover-to-cover basis. Fortunately, about half of the scientific work of the world, even that originally published abroad, is in English and many other publications need not be translated because they are available in either French or German, languages with which many of our advanced research workers are presumed to be familiar.

The translation of foreign scientific documents has become a problem in the period since World War II. This can be traced to two major causes. National traditions and domestic requirements have too often resulted in the publication of scientific documents in lesser-used languages, rather than in English, German, and French. A second reason is the increasing quantity and quality of Soviet and Chinese scientific literature—published in Russian and Chinese only. Japanese is the third most important language for current research publication after English and Russian, and also affords acute translation problems. Some eminent American scientists also believe that the current generation of American scientists are not properly qualifying themselves in French and German during their study for higher degrees, a situation which adds further to the translation load.

The translation problem is substantial, not only because of the time consumed but because of the shortage of linguists who possess sufficient technical qualifications to make accurate translations of foreign language scientific documents. Cost has become a sometimes overriding factor. The National Science Foundation estimates that it costs on the average of 3 cents a word to obtain a good translation of,

say, a Russian scientific paper. This alone tends to hold down the amount of translating work done and necessarily dictates a high degree of selectivity in deciding which magazines and books are to be given cover-to-cover translation. The president of the National Federation of Science Abstracting and Indexing Services stated that he would not recommend a substantial increase in "cover-to-cover" translation but would expand the selective translation of specific articles of significant interest as determined by review of abstracts by American scientists.

In the last few years tremendous enthusiasm for mechanical translation of languages, using high speed electronic computers, has sprung up in this country, England and the Soviet Union. Yehoshua Bar Hillel of Hebrew University, Jerusaiem, Israel, in a Report on the Status of Machine Translation in the United States and Great Britain, prepared under contract with the U.S. Office of Naval Research, states that in the United States alone something like a million and a half dollars was spent in 1958 upon research connected with the development of techniques for machine translation of foreign languages. Bar Hillel states that while there are no exact figures on the number of people engaged in such research in the U.S.S.R., he believes that the number is higher than in the United States. He adds that there are two centers of research in England and a third in process of formation. The great interest in mechanical translation (MT) sometimes leads to overoptimism. Newspaper reports describing efforts here and in the U.S.S.R. often leave the impression that MT is no longer theory but accomplished fact. Actually, results obtained so far cast considerable doubt on the possibility of attaining fully automatic high-quality machine translation within the next 5 years. This does not mean that machines cannot become highly useful mechanical aids to translation, by using either computer programs, which would provide very high-quality partial translations requiring human postediting effort or, for some kinds of translation where volume is more important than quality, programs producing relatively low-quality but high-volume translations with little or no human postediting effort.

Mechanical translation is very attractive from the standpoint of cost because it may become possible eventually to translate for as little as one-half cent a word, as compared with 3 cents per word to produce a single typewritten copy by a human translator. Some researchers see a need for special-purpose computers to be used for MT, but most people in the field believe that existing general-purpose computers can be used for research purposes and that precise requirements for special-purpose computers are not yet clear. Large capacity storage devices and scanning equipment for the automatic recognition of letters and characters are very essential research projects in this field.

STORAGE AND RETRIEVAL OF INFORMATION

The vast quantity of scientific documents being collected poses a real problem in the storage and rapid retrieval of such information. It was stated earlier in this report that the Library of Congress had on the order of 1½ million books on scientific subjects and that the Department of Agriculture Library and the National Library of Medicine each had more than a million volumes in their particular fields. This does not begin to take account of the separate mono-

graphs, papers, and periodical literature in the holdings of many other science collections in libraries throughout the country. When this large amount of available information is considered in total, it becomes reasonable to assume that conventional storage methods and conventional methods of identifying specific documents bearing on relatively narrow fields of science are much too slow and incapable of permitting a truly comprehensive search.

Automatic data processing equipment has also entered this field and is now being used for the storage and retrieval of information.[1] In some of these applications the tape storage medium is used to record items of information which serve to identify documents, equivalent to the subject headings or index entries of more conventional information systems. An example in point is the automatic information retrieval system in operation at General Electric Co.'s Aircraft Gas Turbine Division laboratories in Cincinnati. This system, in operation since 1958, now contains over 37,000 indexed documents pertaining to flight propulsion and related subjects. It utilizes a general-purpose digital computer. Searches for information can result in either a list of accession numbers identifying pertinent documents or print-out of the citation and brief abstract of each document so identified.

At the IBM Research Center in Yorktown Heights, N.Y., research on information retrieval and document analysis is directed toward the design of systems for automatic encoding, indexing, and abstracting of documents. Texts recorded on tape or punched cards are analyzed by machine to determine key words and their positional relationships. Statistical methods are used to select the more significant sentences, which are printed out as an abstract.

The National Bureau of Standards is conducting a cooperative program with the U.S. Patent Office looking toward the mechanization of patent search operations. These and many other efforts to mechanize and speed up the processes of information storage and retrieval are providing worthwhile results and will gain much wider acceptance in the near future. One interesting proposal would have the output of a translating computer become the direct input to a storage and retrieval device.

DISTRIBUTION—REPRODUCTION AND LENDING

The most important step in the dissemination of scientific information is that of insuring easy access of this information to American scientists. Perhaps this should be the simplest task of all; in reality it becomes the most difficult, not only because of logistics but because it involves overcoming the inertia of the American scientist and entering into competition for a portion of his time. It is believed by many that the most effective and economical way of bringing world scientific information to the attention of American scientists and stirring their interest in it is an effective system of distribution of abstracts. Carefully prepared abstracts are economical to distribute widely and permit the individual scientist to keep himself abreast of worldwide scientific developments in his field with little expenditure of time. Carefully prepared abstracts encourage scientists to seek copies of articles of interest, either through lending libraries, purchase, or photographic reproduction.

[1] National Science Foundation, Current Research and Development in Scientific Documentation No. 4 (April 1959).

Having learned of an interesting article, an individual may then place an order for a photographic reproduction of the item if the original is deposited in the Library of Congress, the Department of Agriculture Library or the National Library of Medicine. For example, the Library of Congress offers a wide variety of photographic duplications, including photostats, microfilms and enlargement prints from microfilms, photographs (both negatives and prints) and electrostatic positive prints. Many private libraries, such as the John Crerar Library in Chicago, also offer photocopy services.

Translations are made available through either the Office of Technical Services (OTS) in the Department of Commerce or the Special Libraries Association (SLA) Translations Center at the John Crerar Library, Chicago. OTS collects translations from governmental agencies, both domestic and foreign, while the SLA Translations Center collects translations from nongovernmental agencies, including private industry, societies, and educational institutions both in this country and abroad. Copies of all translations received by either OTS or the SLA Translating Center are available at either. Identical indices and files pertaining to translations are maintained at both centers. The OTS semimonthly publication, "Technical Translations," lists materials available in translation at OTS, the SLA Translation Center or cooperating depository libraries, including Massachusetts Institute of Technology, Georgia Institute of Technology, Pennsylvania State University, Carnegie Library in Pittsburgh, and University of California at Los Angeles. Government research reports are made available to industry by direct sale through OTS.

These facilities, extensive though they are, are in need of improvement. Photographic reproductions are expensive and the individual researcher may think twice before he orders copies of the many books that abstracts indicate are of value. Time is also a vital factor. It often requires 3 months or more from collection to distribution to individual user. The accelerated research-development-production cycle of today demands that this time delay be reduced. Much of the most valuable scientific information is contained in periodic journals. Regional centers throughout the United States where complete science journal collections can be housed and serviced would be of great value.

LEGISLATIVE ACTION

The testimony before the committee showed that there is available throughout the world valuable untapped scientific information. There is no doubt that research cannot only be stimulated but proceed with orderly progressiveness by a study of such writings. However, as is the case in many instances, the availability of these works depends upon the availability of funds necessary to secure their translating, abstracting, and indexing.

The money problem in this field is not new. In particular, the 85th Congress amended the Agricultural Trade Development and Assistance Act, adding a new section 104(k) to Public Law 83–480, authorized the use of foreign currencies accruing under this program for the purpose of collecting, translating, abstracting, and disseminating scientific and technical information and also for the support of scientific activities overseas, including a cooperative program with foreign countries. This basic theme has been given further recognition

by the Congress through the enactment of an additional amendment to Public Law 83–480 known as section 104(n). This amendment provides for the financing, under the direction of the Librarian of Congress, and in consultation with the National Science Foundation, of programs for analysis and evaluation of foreign books, periodicals, and other materials to determine whether they would provide useful technical information to American scientists. The amendment further provides for the indexing, abstracting, translation, and dissemination of such books considered to have such value, and their acquisition and deposit in libraries and research centers in the United States. Both of these sections of Public Law 480 require appropriation by the Congress in order to carry out their provisions.

With this as a background, and acting under the belief that the aforecited provisions were too restrictive to provide most satisfactorily for the collecting, translating, and dissemination of foreign scientific documents, there was proposed to be added to H.R. 7500 (the Mutual Security Act of 1959) a section authorizing the use of foreign currencies that might be available under any provision of law, to be utilized by the President in his discretion for science and research, including translation. The Committee on Foreign Affairs of the House favorably reported H.R. 7500 with the new section; however, the Senate failed to approve the section and the bill was sent to conference. The conferees did not restore this section, but did include language amending section 104(k) of Public Law 83–480, which amendment added research as a purpose, and further accepted in some measure the philosophy of the House proposal by broadening the purposes for which foreign currencies under this section might be utilized. It further provided for appropriation of funds that may become available under the Mutual Security Act, Public Law 480, or any other provision of law. While this does not eliminate the requirement of appropriation, the provision nevertheless, by combining foreign currency with budgetary and other funds, may form the basis for a sound and comprehensive policy leading to an improved program for collection and translation of foreign scientific information.

There are many advantages to be gained from a well-designed program for the utilization of foreign currencies in the gathering of scientific information. First, it is one of the most useful purposes to which these funds can be put. It does not disturb the budget of the U.S. Government agency concerned nor the economy of the country in which the funds are expended. It also has the effect of gathering scientific information on a broad base of interest rather than the relatively narrow field of interest of each U.S. Government agency. Skilled translators are available in many other countries and their employment can materially shorten the time and lessen the cost of placing complete translations in the hands of American scientists. Wise administration of such a program can be most helpful in strengthening friendly relationships and cooperative efforts between scientists in this country and those throughout the world.

CONCLUSIONS

Basic research and new technology are the foundations of the research and development effort on which we expend some $10 billion each year in the United States. This vast effort requires the dis-

covery of new knowledge in the fundamental sciences at a very rapid rate. Years used to intervene between the generation of such knowledge and its application to the design and construction of useful materials and devices. Now the period is frequently measured in months. The United States has no monopoly on the generation of new scientific knowledge. New theories, valuable research results, and advanced technology are available in many parts of the world. If U.S. scientists are to keep abreast of world science and we, as a nation, are to retain leadership in science and technology, we must gather scientific information wherever it exists and make it available rapidly and in effective form to American scientists.

Under the provisions of the National Defense Education Act of 1958, the National Science Foundation has been given a great responsibility—that of providing or arranging for the provision of "indexing, abstracting, translating, and other services leading to a more effective dissemination of scientific information" and undertaking of "programs to develop new or improved methods, including mechanized systems, which make scientific information available." In discharging these responsibilities, the National Science Foundation coordinates its efforts with those of many other Government agencies, including the Library of Congress, the National Library of Medicine, the Department of Agriculture Library, the Office of Technical Services in the Department of Commerce, the Smithsonian Institution, and others engaged in the collection, exchange, and distribution of scientific information, Private indexing and abstracting organizations have been established to serve the particular needs of scientific groups. The scientific information services rendered by many scientific societies and professional institutions to the scientific community are world famous for their quality. It is essential that the Federal Government continue to cooperate with and assist such private groups in the achievement of long-range solutions to scientific information problems.

The Library of Congress, Department of Agriculture Library, and the National Library of Medicine, when viewed collectively, constitute a national science library having holdings totaling more than 3½ million volumes. These collections are the most extensive in the world. Each of the libraries, in its field of interest, continues to add to its collection through purchase and exchange agreements throughout the world. While these great Government libraries and the large group of cooperating libraries throughout the country are doing a highly effective job, there is need for additional distribution centers for periodic journals.

The busy American scientist cannot begin to examine all the scientific literature available to him. If real value is to be gained from the large collections of science documents, means must be provided for the scientist to select in a minimum of time those publications which are of value to him in his particular field. The mere publishing of lists of titles and authors is helpful, but most useful is the preparation of a short and accurate summary of each document. These abstracts can be prepared and distributed widely in a reasonably short period of time. This highly important effort should be given wholehearted support by both Government agencies and private organizations.

Before World War II, most of the world scientific literature was published in at least one of three languages: English, German, or

French. A large number of our scientists are able to read both French and German; hence, but very little language barrier existed at that time. Since World War II, however, national traditions have restricted, generally, the publication of new scientific documents to the language of the country. Also since World War II, the quantity and quality of scientific papers published in Russian, Chinese, and the languages of other Eastern countries have greatly increased. Many Government agencies and private organizations throughout the country have undertaken the abstracting, and in some cases, the cover-to-cover translation of Soviet publications. Lack of funds has limited this effort insofar as Chinese and other Eastern literature is concerned. Additional funds must be found to support this essential service.

There are two highly important phases which are time consuming and costly in terms of money. As the volume of high-quality Russian, Chinese, and other Eastern language literature increases, the translating problem will increase. As the total quantity of scientific literature increases, the storage and retrieval problem becomes more complex. Costs of human services in the case of each are rising. Fortunately, translating, storage, and retrieval processes can be mechanized to some degree with great savings in time and money. There is need to continue the considerable research effort now being conducted into the use of high-speed electronic computers. We may never attain fully automatic, high-quality machine translation, but machines will certainly be used in the future to reduce human work greatly.

Efforts by members of this committee to amend existing legislation would permit highly useful employment of foreign currencies to collect, index, abstract, and translate foreign scientific documents abroad. This legislative change is important also from the standpoint of the encouragement given to friendly relationships and cooperative efforts between scientists in this country and abroad.

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SCIENTIFIC MANPOWER AND EDUCATION

Deficiencies in the Tabulation and Study of Scientific Manpower

REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS
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LETTER OF SUBMITTAL

COMMITTEE ON SCIENCE AND ASTRONAUTICS,
HOUSE OF REPRESENTATIVES,
Washington, D.C., September 7, 1959.

Hon. SAM RAYBURN,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the enclosed report, "Dissemination of Scientific Information."

This report has been prepared following investigative hearings by the full committee. The report makes clear that it is not enough to do research. The results must be made available to other scientists and scholars if the maximum benefits are to be obtained.

The findings and recommendations herein are, therefore, earnestly offered to the 86th Congress for consideration.

OVERTON BROOKS, *Chairman.*

LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., August 21, 1959.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report on "Deficiencies in the Tabulation and Study of Scientific Manpower," prepared by Philip B. Yeager in collaboration with other members of the staff.

The report follows a period of committee inquiry, extending from February through June 1959, into the general problems of scientific manpower and education, plus a special examination of current efforts to keep track of the Nation's scientific and technical personnel. It complies with the directive of the full committee on August 6, 1959, to prepare such a report together with a committee resolution covering the immediate problem.

CHARLES F. DUCANDER,
Executive Director and Chief Counsel.

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86TH CONGRESS, 1st Session } HOUSE OF REPRESENTATIVES { REPORT No. 1180

SCIENTIFIC MANPOWER AND EDUCATION—DEFICIENCIES IN THE TABULATION AND STUDY OF SCIENTIFIC MANPOWER

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. BROOKS of Louisiana, from the Committee on Science and Astronautics, submitted the following

REPORT

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SCIENTIFIC MANPOWER AND EDUCATION

Deficiencies in the Tabulation and Study of Scientific Manpower

Introduction

On February 25, 1959, the Committee on Science and Astronautics began a series of hearings designed to acquaint members with the status, needs, and problems of the Nation's scientific manpower and education.

The hearings were extensive, running intermittently through May 1959. More than 30 expert witnesses appeared.

At that juncture the committee paused to evaluate the information presented to it and, on the basis of testimony thus far received, one major area of the scientific manpower problem appeared to warrant immediate attention. This was the problem of keeping track of the Nation's scientific and technical personnel, of knowing who these people are, where they are, what they can do. The hearings had disclosed that there is no place nor any organization which has comprehensive up-to-date information covering all scientific and technical personnel.

Consequently, the committee held additional hearings in June, inquiring further into current programs for tabulating and studying the scientific and technical manpower of the United States. Additional witnesses, specialists on the subject under inquiry, appeared before the committee; additional information was filed with the committee staff; reports on the subject which had been conducted by other groups in the near past, official and semiofficial, were studied.

It became clear to the committee that the Government's present efforts to create a useful census of scientists, engineers, and technicians—efforts being coordinated by the National Science Foundation under its 1950 charter—needed a substantial boost.

The chairman of the committee thus introduced on June 26, 1959, H.R. 7981, a bill which would have provided for a special ad hoc interdepartmental commission in the executive branch to review the entire problem and report its findings and recommendations back to the Congress. However, at a meeting of the committee on August 6, 1959, it was decided that a more immediate approach should be followed. The committee approved a resolution requesting the National Science Foundation to consult with all executive agencies concerned with the matter and report its findings and recommendations back to the committee by the beginning of the 2d session of the 86th Congress in January 1960.

The resolution is as follows:

COMMITTEE RESOLUTION ON THE TABULATION AND STUDY OF SCIENTIFIC AND TECHNICAL MANPOWER

Whereas the National Science Foundation Act of 1950 contains the following directive: "The Foundation is authorized and directed * * * to maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States, including its Territories and possessions"; and

Whereas the legislative history of the act shows that Congress attached high urgency to this matter; and

Whereas testimony before the committee indicates that Congress' directive has not been adequately implemented thus far and that this fact has been recognized by the National Science Foundation as well as other executive agencies and private organizations; and

Whereas testimony before the committee suggests that the register of scientific and technical personnel and its companion manpower studies have not been allowed the priority granted to other programs of the National Science Foundation; and

Whereas nearly a decade has gone by since the National Science Foundation was created and charged with responsibility in this general area; and

Whereas the world situation today makes an effective tabulation of scientific and technical manpower more critical than at any time in the history of the country: Now therefore be it

Resolved, That the Committee on Science and Astronautics of the House of Representatives request the National Science Foundation to submit to the committee on or about January 4, 1960, a comprehensive report covering (A) the status of the scientific and technical manpower register and the scientific manpower studies, and (B) the projected plans for the future, short-range and long-range, in these areas.

That in the preparation of this report the National Science Foundation should consult with other interested agencies of Government, including the Department of Commerce, the Department of Labor, the Department of Defense, the Department of Health, Education, and Welfare, the Civil Service Commission, the National Aeronautics and Space Administration, the Office of Civil and Defense Mobilization, the Selective Service System, and the Central Intelligence Agency, and include in its report summaries of the specific interests, needs, and recommendations of such agencies.

That in the preparation of this report, the National Science Foundation should seek the advice and assistance of the Federal Council for Science and Technology and of such private organizations as may be deemed appropriate.

That the National Science Foundation, in submitting the report, should indicate—

(a) How the Foundation proposes to secure appropriate information on both the formal training of scientific and technical personnel and their subsequent experience;

(b) What type and kind of information an effective register could most advantageously supply and should be expected to provide;

(c) In what manner and through what means such a record may best be maintained;

(d) The pertinent findings and recommendations of the Foundation itself following evaluation of information produced by this study.

That in making any recommendation to the committee, the National Science Foundation should include, among other things, the following:

(1) The probable cost of any recommended program, including the cost of maintenance and of adequate methods for keeping the program current.

(2) The estimated length of time which may be required to place an improved scientific and technical manpower tabulation program in operation.

(3) Whether the best results could be expected through compulsory or voluntary means.

(4) What agency of Government should bear responsibility for the program, and whether that responsibility should be exclusive or merely primary.

(5) What agencies of Government should be expected to cooperate with the agency responsible for the program and the manner in which such cooperation should be carried out.

(6) What amendments, if any, to laws now affecting scientific and technical manpower tabulations or registers should be made.

AUGUST 6, 1959.

BACKGROUND

The very great importance of keeping track of scientific and technical personnel became evident around 1939–40 as the war clouds of World War II gathered. By that time the world was becoming aware that mere manpower and resources were no longer sufficient for the security of any nation. Scientific know-how had become another requisite.

In 1940, however, the United States had no census of scientists and technicians, as such. Hence it was necessary for the President to promulgate the establishment of a "National Roster of Scientific and Specialized Personnel," with the hope that such a roster would develop reasonably complete information on the identity, whereabouts, and experience of scientists who had particular skills necessary to the prosecution of the war effort. In June 1940, the roster was placed under the direction of Dr. Leonard Carmichael, then president of Tufts College and now Secretary of the Smithsonian Institution. Eventually more than 1 million persons were registered. The Selective Service System worked closely with the roster in efforts to guide specialists into areas where they would be most useful. These efforts sometimes failed spectacularly, but on the whole the arrangement was a notable improvement over previous ones improvised during emergency periods.

By the end of World War II, national emphasis on science reached a new high. Significant advances, particularly in the fields of electronics and atomic energy, assured a highly prominent role for the scientist, engineer, and technician in the future, not only in the world of commerce but in the conduct of the affairs of Government.

It was in this atmosphere that the Congress, as early as 1945, began consideration of the establishment of a Federal science agency, part of whose function would be to maintain a continuing record of the Nation's scientists, engineers, and technicians.

The history behind the "National Register of Scientific and Technical Personnel," as operated today by the National Science Foundation, is best described by these excerpts from a legislative study done within the Foundation in February 1958:

> The two provisions of the National Science Foundation Act of 1950[1] which relate to and provide the basis for the national register of scientific and technical personnel are as follows:
>
> "SEC. 3. (a) The Foundation is authorized and directed—
>
> "(8) To maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information concerning all scientific and technical personnel in the United States, including its Territories and possessions.
>
> "SEC. 14. (i) The National Roster of Scientific and Specialized Personnel shall be transferred from the United States Employment Service to the Foundation, together with such records and property as have been utilized or are available for use in the administration of such roster as may be determined by the President. The transfer provided for in this subsection shall take effect at such time or times as the President shall direct."
>
> * * * * * * *
>
> Briefly stated, the record shows that a register provision was included in the very first bill to bear the title "National Science Foundation Act" introduced in

[1] Public Law 507, 81st Cong., 2d sess.

December 1945. This first provision was substantially the same as that which became law in 1950, there being only four differences, two minor and two significant. Furthermore, the register provision appeared in every one of the dozens of Foundation bills, without exception in both Senate and House, throughout the entire 5 years of the turbulent history of the effort to pass a National Science Foundation Act. The same is true of the provision for transfer of the national roster to the Foundation, except that this provision appeared originally in the second bill rather than the first.

There were many references to the register throughout the 5 years, all favorable except for a challenge in 1950. But even here the challenge, which was brief and unsuccessful, was directed at who should maintain the register rather than against the concept of maintaining it.

Origin of register provisions in 1945 and 1946

The first bill to bear the title "National Science Foundation Act" was S. 1720, introduced by Senator Kilgore on December 21, 1945, during the last days of the 79th Congress, 1st session. This bill included the following:

"SEC. 7. The Administrator shall maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information concerning all scientific and technical personnel in the United States and its possessions. No individual shall be listed in such register without his consent."

This was the first provision for a Foundation register to appear in any bill. It will be noted that the basic wording is virtually identical with that included 5 years later in the act of 1950. There are only four differences: (1) The original "The Administrator shall maintain" later became "The Foundation is authorized and directed to maintain"; (2) "in the United States and its possessions" became "in the United States, including its Territories and possessions"; (3) the second sentence, "No individual shall be listed in such register without his consent," was deleted; and (4) the register section, which in 1945 was paired with the section on scholarships and fellowships in about the middle of the bill, was moved up in the act of 1950 to a place in section 3 among the eight basic functions of the Foundation.

Two months later, on February 21, 1946, in the 79th Congress, 2d session, Senator Kilgore introduced a new and somewhat revised bill, S. 1850. This included precisely the same section 7 providing for a register. It also contained a provision for transfer of the old national roster to the Foundation. * * *

The Senate committee report on S. 1850 contains the first substantive congressional comment concerning the register:

"The experience of war agencies has demonstrated the importance of placement facilities for scientific personnel. The success and usefulness of the national roster of scientific and specialized personnel and of the Office of Scientific Personnel suggest that the Foundation should maintain an up-to-date register of trained personnel which would be particularly useful—

"(1) In meeting the personnel needs of its own programs.

"(2) In placing the scientific personnel trained through the Foundation's programs of scholarships and fellowships.

"(3) In selecting scientific personnel to meet the Nation's need in time of war or other national emergency."

On the Senate floor there was much discussion of S. 1850 on July 1, 2, and 3 and many of its features were debated vigorously, but there was no objection to or discussion of the register provisions. On July 3 the bill was passed by the Senate.

In the House of Representatives the first bill introduced was H.R. 6448 by Congressman Mills of Arkansas. Also introduced was H.R. 6672 by Congressman Celler. Each included precisely the same wording as S. 1850 concerning the register. But there was no House committee report and no floor comment on the register provisions. The House did not pass either of these bills "because the pressure of legislative business at the close of the session was such that the House adjourned before it could take action."

Passage and veto in 1947

During the 80th Congress, 1st session, two competing bills were introduced in the Senate on February 7, 1947, S. 525 by Senator Thomas and S. 526 by Senator Smith. Each contained precisely the same register provisions as in S. 1720 of 1945 and S. 1850 of 1946 quoted above. The Senate committee reported favorably on S. 526 and made the following comment concerning the register in its report:

"In order to maintain a record, in case of future need, of scientific and technical personnel, and in order to assure the optimum utilization of such personnel,

the Foundation is to maintain a register of such men and to act as a central clearinghouse for information concerning them. No charges of regimentation can validly be made, since the bill expressly provides that no individual shall be listed in this register without his consent."

* * * * * * *

After 5 days of debate the Senate passed S. 526, the vote being 79 to 8 with 8 not voting. As passed, the bill contained the register provisions, without change and without comment other than quoted above.

In the meantime on February 10, 1947, three bills identical with S. 526 had been introduced in the House, H.R. 1815 by Congressman Case, H.R. 1830 by Congressman Mills, and H.R. 1834 by Congressman Priest, and on February 18 a fourth was introduced by Congressman Hays, H.R. 2027. An earlier bill, H.R. 942, was also considered. The bill finally reported out by the House committee on July 10, 1947, was H.R. 4102, introduced by Congressman Wolverton of New Jersey. This bill contained the same wording providing for a register, in section 10(b). The only comment concerning this section in the House committee report was as follows:

"By subsection (b) the Foundation is directed to maintain a register of scientific and technical personnel, but no individual may be listed in such register without his consent."

The bill was discussed in detail on the House floor on July 16, but without reference to the register, and passed on the same day.

* * * * * * *

On August 6, 1947, President Truman pocket vetoed the bill for several reasons, the principal one being that a Board of part-time officials would be given control, including selection of the Director, which would prevent the President from effective exercise of his constitutional duty of controlling the execution of the law. He did this with regret, being otherwise in favor of the bill. This Presidential message made no reference to the register provisions.

Reports and discussion in 1948; deletion of "without consent" clause

During the 80th Congress, 2d session, the only event of interest with respect to the register was the dropping of the last sentence in the provision which had remained unchanged since 1945: "No individual shall be listed in such register without his consent." The revised section then read as follows:

"The Foundation shall maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States and its possessions."

The one-sentence provision was included in S. 2385, which was introduced on March 25, 1948, by Senator Smith jointly with seven other Senators. This bill was reported favorably by a Senate committee on April 20, the report containing the following minimum reference to the register: "A roster of scientific personnel is to be maintained." An equally brief mention of the transfer of the national roster to the Foundation was made on page 5 of the same report. The Senate discussed this bill intensively on May 3, 4, and 5; made some amendments (none affecting the register); and passed it by voice vote on May 5, 1948.

In the meantime Congressman Priest had introduced H.R. 4852 on January 6, containing the same one-sentence provision for a register and the usual provision for transfer of the national roster. On March 25 Congressman Wolverton introduced H.R. 6007 which was reported June 4, accompanied by House Report No. 2223, including these register provisions. This bill failed to reach the House floor, so no legislation reached the President.

Bills and reports in 1949; increased status for the register

Senator Thomas introduced S. 247 on January 6, 1949, jointly with six other Senators (Kilgore, Fulbright, Magnuson, Smith, Cordon, Saltonstall). It included the one-sentence register provision and the usual provision for transfer of the roster to the Foundation. On March 3 a favorable report was submitted, including minimum reference to the register section: "A roster of scientific personnel is to be maintained." A similar minimum mention of transfer of the roster was made on page 7.

In the House seven bills were introduced. Four (H.R. 12, 185, 311, and 2751) were identical with the H.R. 6007 which had been favorably reported the preceding year. Two (H.R. 1845 and 2308) were identical with S. 247 mentioned in the preceding paragraph. One (H.R. 359) differed substantially from all the others, incorporating provisions rejected in previous years. The first six of these bills included the one-sentence provision for maintaining a register, and the usual

provision for transfer of the roster. H.R. 359, however, reverted to 1947 by including the sentence, "No individual shall be listed in such register without his consent."

The House committee reviewed these seven bills and all the testimony of the preceding 4 years, then drafted a new bill, H.R. 4846, which was introduced by Congressman Priest on May 24, 1949. "The committee believes that H.R. 4846, as amended, is a better bill with respect to form, as well as content, than any bill on the subject heretofore proposed, and that it meets the objections expressed by the President in his (veto) memorandum of August 6, 1947, with respect to S. 526."

With respect to the register, a significant change had indeed been made, clearly increasing its status. Up to this point the provision for maintenance of a register had been, since 1945, invariably linked to the section or subsection concerning scholarships and fellowships, and located (usually as about section 9 or 10) about midway in the bill. Now the register was moved up to section 3, following only the enacting clause and the establishment clause, and was made one of the eight basic functions of the Foundation. Two slight changes in wording were concurrently made: (*a*) instead of "The Foundation shall maintain a register * * *" the mandate was changed to read "The Foundation is authorized and directed—to maintain a register * * *"; and (*b*) instead of "* * * in the United States and its possessions." the wording was changed to "* * * in the United States, including its Territories and possessions."

* * * * * * *

Neither the House bill nor the Senate bill reached the floors of Congress during 1949, so no National Science Foundation legislation was passed that year, but H.R. 4846 had laid the basis for successful enactment the following year.

The register in 1950

The Senate had passed S. 247 on March 18, 1949, during the first session of the 81st Congress and allowed it to stand during the early part of the second session while the House considered similar legislation. During this second session in 1950 nearly all of the floor discussion was in the House. * * *

Final enactment in 1950

On March 1, 1950, the House passed H.R. 4846 by a vote of 247 to 126. They then immediately substituted the contents of this bill for S 247, by voice vote, and sent it to the Senate.

On March 27, 1950, the Senate disagreed with the House substitution and appointed conferees (Senators Thomas of Utah, Murray of Montana, Lehman of New York, Taft of Ohio, and Smith of New Jersey). On the next day the House also appointed conferees (Congressmen Priest of Tennessee, Biemiller of Wisconsin, and Wilson of Oklahoma).

The conferees presented their report to the House on April 27 (H. Rept. No. 1958). In general the House provisions had prevailed, but a few changes had been worked out in conference. Since both the House and Senate revisions contained the same register provision, there was no discussion of the register. The Senate-House conferees had agreed unanimously, and after some discussion the House passed the amended bill (S. 247) by voice vote.

The Senate considered the same report on the following day and after brie discussion passed the same bill by voice vote.

On May 10, 1950, the bill was signed by the President and became law.

Stewardship of the Science Foundation

The National Science Foundation thus did not really swing into operation until 1951, at which time it inherited the old "Roster of Scientific and Specialized Personnel." The roster appears to have been, by that time, badly out of date and difficult to handle. However, it was a start, and it represented some experience in the field on which the Foundation might draw.

Difficulties which the Foundation faced have been described to the committee by Dr. Harry C. Kelly, Assistant Director for Scientific Personnel and Education:

Our most serious obstacle, however, during the early 1950's, in our efforts to understand our scientific manpower and training needs, was the lack of adequate

information. Estimates, in 1950, of the number of scientists and engineers in the country were based upon bits and fragments of information. No organized or sustained effort had been made to find ways to measure either current or long-range need.

Not until 1947–48 was there a general report on the number of college degrees granted in all the separate fields of science and engineering per year. No general survey had provided adequate information on the employment of our scientists and engineers in industry, education, and government. There were some scattered efforts to piece together some knowledge and understanding of the professional characteristics of our scientists and engineers, but they were poorly supported and fell far short of our actual needs.

At the beginning of this decade, we had very little idea of the nature and magnitude of the problems in science education which lay ahead. Furthermore, even though we had become acutely aware of the growing threat of the U.S.S.R., there had been only a rudimentary effort to make provisions for the utilization of our scientific and technical manpower resources in the event of national emergency or war.

Not only were we seriously hampered in those years by the lack of information needed for planning the nature and optimal size of our program approaches to education in the sciences, we were faced, also, with a general attitude of apathy toward support of the means to collect this information.

At present the National Science Foundation is undertaking to fulfill its 1950 congressional mandate to keep track of scientists and technicians and provide information concerning them through two main channels:

(a) Scientific manpower studies.

(b) The register of scientific personnel.

These particular endeavors, together with their objectives, were described to the committee by Dr. Kelly as follows:

This general legislative mandate we have translated into four principal objectives as guidelines to us for the program.

1. Provision of data regarding the supply, utilization, characteristics, training, fields of specialization of and demand for scientific and technical personnel so that the Foundation may consider relevant factors of scientific personnel resources in the development of its programs and as advisory to other Federal and non-Federal agencies.

2. The provision of a central clearinghouse for scientific manpower information so that other Government agencies, professional societies, private organizations, and others concerned with scientific and technical personnel may have access to information required for administering their programs.

3. Maintenance of the National Register of Scientific and Technical Personnel so that scientists and engineers with highly specialized skills may be identified, located, and placed in priority assignments if emergency conditions require it.

4. Administration of a limited program of research in order to sharpen and improve our methods for measuring demand, supply and characteristics of scientific personnel, and to develop a better understanding of the institutional framework in which scientists and engineers are employed.

This operation is under the direction, in our division, of Mr. Thomas Mills, who leads the unit, scientific manpower studies, sometimes called the clearinghouse.

It is largely concerned with a compilation and analysis of information. Its activities, include information on the supply, needs, characteristics, utilization, training, and so forth of scientific and tecnnical personnel, and provision for release in useful forms for program and planning guidance.

The other unit, the National Register of Scientific and Technical Personnel, is concerned with the registration of scientists and engineers, the processing of this information to make it readily available, and the servicing of requests for information on scientific personnel included in the register.

It is our expectation that a third unit will be added to this program in the near future. This unit will be concerned with research into concepts underlying scientific manpower data collection and improvement of methods of securing such information.

Generally, the Foundation's scientific manpower studies are based upon information collected by other organizations, both private and public. This involves the review and analysis of materials originally collected by such agencies as the

U.S. Office of Education, Bureau of Labor Statistics, Bureau of the Census, National Research Council, and many others concerned with one or more aspects of scientific manpower.

The review of scientific personnel information provided through these other organizations frequently reveals certain data deficiencies. This is not to imply necessarily faulty workmanship on the part of these organizations, but rather to emphasize that these data are usually collected as a small part of a larger whole in which scientific personnel information is incidental. As these inadequacies become apparent, the scientific manpower studies program undertakes to secure better information. This may require direct collection or assistance to other organizations in their collection efforts. Each of these methods has been used on occasion.

Register statistics

According to information provided the committee the National Science Foundation estimates, on the basis of its definitions, that there are about 212,000 physical scientists in the United States and about 75,000 life scientists—a total of close to 300,000. The Foundation estimates there are roughly 850,000 engineers in the United States. It believes that it may be in error by as much as 10 percent in either direction on these figures.

Of such personnel, Foundation witnesses testified that present information, collected in 1957 and 1958, covers a total of 170,000 scientists of all types—plus a "finders list" of about 20,000 key engineers.

Budget allocations

Due to changing methods of accounting, it is difficult to obtain a fully accurate historical picture of the budgetary importance which the National Science Foundation gives to its scientific register and manpower studies. However, data provided the committee in regard to Foundation appropriations and obligations over the past few years does not suggest that this facet of the Foundation's work has gained stature within the overall budget.

In fiscal 1960, for example, the Foundation contemplates $400,000 for its register—which is 0.0025 of its administration-approved budget of $160,300,000. This is somewhat less proportionately than the $381,000 for fiscal 1959—which was 0.0028 of a $134 million appropriation. The same trend shows up concerning the entire register-manpower studies budget. That is, the $1 million allocated for 1960 is 0.0062 of the 1960 appropriation, while 1959's allocation of $860,000 was 0.0064 of the total Foundation appropriation for that year. Going back to fiscal 1958, the figures indicate about the same pattern.

In addition, it might be pointed out that the Foundation initially requested $1,450,000 for its overall manpower program for fiscal 1960; eventually, however, the Foundation accepted the Budget Bureau's recommendations and cut this amount by 31 percent to $1 million, although not obliged to do so. In other words, reductions imposed by the Budget Bureau might have been applied to other areas of the Foundation budget.

In any event, the fact is that the National Science Foundation is putting less than 1 percent of its total budget into its register and manpower studies.

Organizational setup

Under the terms of its 1950 organic act [2] the National Science Foundation was directed to provide the following divisions as part of its internal organization: (*a*) a Division of Medical Research; (*b*) a Division of Mathematical, Physical, and Engineering Sciences; (*c*) a Division of Biological Sciences; and (*d*) a Division of Scientific Personnel and Education * * * *unless otherwise provided by its governing Board.* The Board was also authorized to establish "such other divisions" as it might find necessary.

At the present time the National Science Foundation is composed of (*a*) a Division of Biological and Medical Sciences, (*b*) a Division of Mathematical, Physical, and Engineering Sciences, (*c*) a Division of Scientific Personnel and Education, and four Offices—International Programs, Science Information Service, Social Sciences, and Special Studies. The Foundation's scientific manpower program has not attained the status of a division or an independent office. It is one of five programs operating under one of the three divisions, the Division of Scientific Personnel and Education.

Thus while the Foundation's governing body, the National Science Board, has seen fit to use its discretionary powers and depart from the statutory organization of the Foundation to some degree, it has not exercised this authority on behalf of the scientific manpower studies or the national register. These programs remain relatively obscure in the overall organizational scheme.

It should be noted further that testimony given the committee by Foundation officials has been to the effect that a staff of three professionals is employed to coordinate the register program and five professionals to coordinate the manpower studies. The bulk of the substantive work is done under contract.

Evaluation of the Manpower Program

During the past several years, and particularly since the advent of the Space Age in the fall of 1957, there has been evidence of dissatisfaction with the Foundation's manpower programs. This concern has come from within the Foundation and without, from other Federal agencies, from private enterprise, and from the professional societies.

It has been charged, for example, that the register of scientists and technicians is too incomplete, too far behind time, and places too little emphasis on practical experience to be of broad value. It has been alleged that the manpower studies themselves, based on incomplete information, cannot provide adequate data for either current purposes or as a means of anticipating national scientific needs.

The year 1958—a time when the entire Government was in a state of intense scientific soul-searching due to sputnik and the International Geophysical Year—produced several specific studies dealing with the shortcomings of our scientific manpower tabulation efforts.

The Gamble report

One of these studies was completed in March 1958, by Dr. Allen O. Gamble, then Director of the Foundation's register and currently Chief, Examinations and Standards Division, National Aeronautics

[2] Supra, note 1, sec. 7.

and Space Administration. Dr. Gamble, who was brought before the committee as a witness, provided the following testimony regarding his study:

Mr. HALL. Doctor, while you were head of this register, did you make any recommendations for expanded services?

Dr. GAMBLE. I did, definitely.

Mr. HALL. What were those recommendations?

Dr. GAMBLE. My recommendations were in three parts or sections. The first five recommendations were aimed at increasing the technical capacity or competence of the register, in relationship to its goals and functions as established under law and as required to serve the national interest. They were as follows:

Recommendation 1: Expand input-processing facilities at the Register Records Center. The objective was to speed up and make more efficient such operations as checking incoming questionnaires, microfilming, card punching, reproducing, sorting, filing, et cetera, so as to eliminate the 2- to 3-year backlog, provide better mobilization readiness, and make manpower statistics more quickly available. Additional space, equipment, staff, and funds were requested in specific terms.

Recommendation 2: Install current-address system. The register depends on professional societies for addresses of their members, and the addresses of nonmembers are several years old in most cases. Current addresses are needed on a continuous basis for a variety of purposes including mobilization readiness, updating of substantive information, statistical studies in terms of geographical location, preparation of specialized directories, et cetera. Since mailing addresses of scientists change on the average about 30 percent a year, a real problem exists. A specific solution to the problem was developed and proposed, including optical scanning and other equipment, procedures, costs, and scheduling.

Recommendation 3: Develop and install systems of updating substantive information. This proposal was to modify the existing system of complete requestionnairing of scientists every 2 or 3 years, by separate treatment of three categories of information. Category I would include personal and historical information such as name, date of birth, sex, citizenship, and educational history. Such information, once incorporated into register files, normally does not change and should not be requested again from the scientist except to have him check it periodically. This would eliminate a source of justified complaints from scientists. Category II would include qualifications information such as field and specialties of primary competence, major professional functions, knowledge of foreign languages and areas, et cetera. Updating such information could be done every 2 or 3 years without great loss of accuracy, again reducing the load on the reporting scientist. Category III would be limited to employment information: employment status (full-time employed, student, et cetera), type of employer, locality of employment, employment specialty and function, and salary. This type of data changes quite rapidly. It should be updated at every change of address, otherwise at intervals of 6 months to 1 year, using a condensed type of checklist questionnaire. This proposal to treat the three categories separately was advanced as requiring some rather difficult technical development but little or no additional funds.

Recommendation 4: Develop improved classification of scientific and technical specialities. No present system of classification, including that of the register, is fully satisfactory for all of the purposes it must serve. A system should be developed which (*a*) is up to date, since the present system is a modification of the one developed in World War II; (*b*) covers all of science and technology; (*c*) is of reasonable length; (*d*) is flexible and expandable to accommodate future growth in any direction, including the unexpected; (*e*) is constructed in block or hierarchical form to allow different levels of fineness of treatment; (*f*) is compatible with other systems such as those of Census and Bureau of Labor Statistics, past and present, so as to allow studies of historical trends; and (*g*) has a coding scheme suitable for machine handling and is compatible with the preceding criteria. It was recommended that at least one full-time register staff member be appointed or assigned to this project. Incidentally, the register central staff consists of three professionals and two secretaries.

Recommendation 5: Develop methods for collecting and using qualitative information. This recommendation proposes that an intensive study be made of the difficult problem of measuring the quality or excellence of scientists and engineers. About a dozen possibilities were listed and discussed.

Action on the preceding five recommendations was proposed to be taken as the first step, in order to strengthen the register's technical capacity and competence.

The following seven recommendations were then intended to increase the active usefulness of the register and make it better known to the scientific and technical community, to users of register information, and to the Nation generally. One particular objective would be to provide feedback of useful service and information to registrants, in return for their work in providing information concerning themselves.

Recommendation 6: Expand output-processing capacity of the Register Records Center. This recommendation refers to statistical analyses of various types, IBM tape listings of specialized selected groups, production of mailing address labels for specialized groups and so forth. Although the register is the richest and in many ways the best source of information concerning the Nation's scientists, output of information has been slow and meager. Both equipment and staff have been badly needed.

Recommendation 7: Obtain authority for cost reimbursable operations. It was recommended that authority be obtained for the register to charge on a cost reimbursable basis for certain services rendered. Such charges would apply only to special purpose analyses of interest to a requesting individual or organization.

Recommendation 8: Provide selective mailing lists of registrants to qualified organizations. Once the register has become operational with its proposed current address system, recommendation 2, it is proposed that mailing lists be made available to Government agencies and nonprofit institutions. Use of such lists would probably be restricted to mailing notices of availability of technical information of interest to the particular selected list, such as translations of Russian documents in astronautics to specialists in space science. Each such mailing would be accompanied by two statements: (1) that the name and address had been furnished by the National Register; and (2) that, if the recipient objects to having his name and address so used, he should notify the register.

Recommendation 9: Make register information available for publication of special directories, jointly with professional societies. Once the proposed current address system is in operation, it would be technically easy for the register to sort special lists of scientists or engineers and produce condensed directories of specialists. Such directories could include all specialists in a narrow field of work, all in a given metropolitan area, and so forth. They could be issued within days of receipt of latest address, rather than the usual year or more for the typical specialized directory. They would facilitate intercommunication among scientists in the same specialty or area, or having the same language skills, and so forth, to the benefit of national progress in science. Safeguards would be used to prevent commercial exploitation, and the work would be done in cooperation with the professional societies.

Recommendation 10: Allow society placement services to use register information for referrals. This is a proposal for investigation of feasibility, followed by action if indicated. It would assist professional societies to use register information for peacetime placement operations, insofar as individual registrants agreed in writing, and would avoid the disadvantages of a Federal peacetime placement activity.

Recommendation 11: Intensify, broaden, and cross-check registration within present fields of coverage. This is a modest proposal—increase of 10 percent to 15 percent in grants to professional societies—to increase coverage in present fields of physical and life sciences. A variety of specific approaches is listed.

Recommendation 12: Conduct publicity and information campaign. If the register is to be a live and maximally useful organization, it must be known and understood by the population it covers, by the organizations it serves or will serve in peacetime or emergency, and by the Nation which supports it through tax funds. The better known the Register is, the higher the response rate to its questionnaires and the more useful its services can be. Several suggestions for action were outlined.

The above 12 recommendations concern operation of the Register within its present fields of coverage. All should take priority over expansion into new fields.

But as soon as significant progress on the preceding recommendations has been achieved or is well underway, the register should begin expansion into new fields of critical national importance. Among these are aeronautical and astronautical science, electronics and communications, metallurgy and ceramics, rockets and missiles, and so forth. Immediately thereafter, expansion should be extended into the other areas of engineering and technology.

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The Hauser report

In August 1958, a special task force which had been instigated by the Executive Office of the President to study the broad-gage problem issued a technical report of considerable scope. This was the so-called Hauser report (named for the task-force chairman, Philip M. Hauser of the University of Chicago). Entitled "A Program for National Information on Scientific and Technical Personnel," this report described its origin and mission as follows:

> The last few years have witnessed a sharp increase of interest in the twin subjects of science and scientific personnel. This growing concern has arisen from the intimate association of economic development and scientific advance, the recent high levels of economic activity, the growing complexity of national defense equipment, and the resulting shortages of scientific and technical skill. More recently, the remarkable advances in foreign scientific achievements have led to searching examination of our resources of scientific personnel, their training and professional characteristics, and probable future supply.
>
> Some recent Government programs dealing with scientific manpower may be cited as indicative of this growing interest. In 1956, the President's Committee on Scientists and Engineers was established to provide leadership for non-Government programs designed to improve the quality and increase the numbers of well-qualified scientists and engineers. In 1957, National Science Foundation programs for the improvement of science teaching were sharply expanded. In 1958, further sharp increases occurred in Foundation programs, and the administration proposed new programs in support of science education. In 1957 and 1958, both the Organization for European Economic Cooperation and the North Atlantic Treaty Organization adopted new programs to encourage member countries to review their scientific manpower situations and develop similar measures.
>
> Two developments occurring about this time are primarily responsible for this document. Early in 1957, the President's Committee on Scientists and Engineers found itself handicapped in its program development activities through lack of agreement on much of the basic statistical data relating to scientists and engineers. The Committee decided to establish a task force on statistics to evaluate existing data and propose methods of remedying deficiencies. An independent development in June 1957 was a request to the National Science Foundation by the Bureau of the Budget for the preparation of a program of collection of needed data on scientists and engineers.
>
> The Budget Bureau's request stated in part:
>
> "We are accordingly requesting the National Science Foundation to develop a program for collection of needed supply, demand, employment, and compensation data with respect to scientists and engineers and for such other professional groups as it considers appropriate. Because of its functions, its relationship to the National Committee for the Development of Scientists and Engineers, and because it has already arranged for studies of employment in scientific fields, we believe the Foundation is the most logical agency to undertake such a task."
>
> The Foundation accepted this assignment and jointly with the President's Committee on Scientists and Engineers organized an Advisory Panel to review and evaluate the available information on the demand and supply of scientists, engineers, technicians, and teachers of science and engineering. The Panel was asked to recommend such inquiries or other measures as in its judgment would provide the additional information needed for policy formulation in the field of scientific and technical personnel.

The report was comprehensive and may have been especially helpful in pinpointing new problems arising in connection with modern scientific manpower research and in suggesting ways to overcome them.

The Wolfle report

The most recent important study of the problem, with specific reference to the operation of the manpower register, was conducted by a special Review Panel under the chairmanship of Dr. Dael Wolfle,

executive head of the American Association for the Advancement of Science.

The Review Panel was established on request by the National Science Foundation, whose officers apparently were not satisfied with results of the register up to that time. Findings of the Panel were reported to the Foundation in November 1958. They were basic in nature and focused on policy considerations, as follows:

1. *The National Science Foundation should come to agreement on the purposes, policies, and scope of the register.*

In recommendation 2, the Review Panel submits its own recommendation concerning purposes, and in recommendation 5 its suggestions concerning scope. Whether or not these recommendations are adopted, it seems to the Panel essential that members of the NSF staff come to agreement, for there is considerable evidence that lack of clear agreement concerning the scope, function, and values of a register are in substantial part responsible for the fact that the register has now collected large masses of data but has relatively little of that data in usable form.

The number of people to whom questionnaires have been sent, the amount of information requested of respondents, and the forms in which records are expected eventually to be available, have been allowed to outrun the facilities available for processing the data. As a consequence, many addresses are out of date, data collected 2 or more years ago are not ready for tabulation and analysis, and neither the NSF nor the cooperating societies have been able to derive benefits from the register to the extent hoped for in its planning.

The Review Panel has some doubts concerning individual items of the method of operation. To cite a single example, at least some of the societies from which information was received do not feel any need to have window cards containing microfilm copies of the questionnaires since the original questionnaires are available and are easier to read. The Panel has agreed, however, that there is no point in discussing the details of space, machine, and personnel requirements and operational procedures at this time. Agreements on the more fundamental policy matters of function and scope should precede discussion of operating details.

2. *The Panel recommends that the two purposes to be emphasized in the register are (a) statistical studies of American scientists and their characteristics, and (b) the availability of names, addresses, and personal data for possible use under mobilization conditions.*

The Panel recognizes that there are other possible uses of a register; perhaps the outstanding one is for peacetime placement purposes. The Panel agrees with the NSF that this is not a proper function of the NSF. The Review Panel takes the position, however, that the cooperating societies should each be free to determine the extent to which it wishes to use its portions of the register for placement purposes.

Still other functions might be developed—for example, the printing of specialized directories. The Review Panel believes that all of these other purposes are of secondary importance, and should not be permitted to interfere with the achievement of the two principal functions.

The register can serve as a valuable source of data for the Foundation's clearinghouse of information function, and in like manner can be used by individual societies for studies of characteristics of the persons within the field of interest of those societies.

The usefulness of the register as a source of statistical data is limited by the fact that coverage is incomplete and by the fact that the register itself can never give information about the total population from which the register sample is drawn. Despite this limitation, the members of the Panel feel confident of their own judgment that rapid and prompt analysis and publication of statistical information from recently collected questionnaires would be of value to institutions and individuals interested in the trends and changing characteristics of America's scientific population. On this point we ask if the Foundation itself feels satisfied that its programs and its recommendations to Congress have been founded on as solid a basis of statistical information as is desirable.

With respect to the mobilization function, the Panel suggests the desirability of securing from the Office of Civil and Defense Mobilization and other potential mobilization users, information concerning the questions that are likely to be

asked of the register and how the register information would be likely to be used under mobilization conditions. The concept of national mobilization has changed drastically during the past dozen years; the experience of World War II and the Korean war probably no longer provide the only good models of what to expect in the future. The Department of Defense, the Office of Civil and Defense Mobilization, and other defense agencies cannot, of course, state in detail all of the eventualities, but must envision various degrees of national emergency. Yet it would be of very great help in register planning to secure from these agencies information concerning the kind of data that would be needed to answer their mobilization requirements, the degree of detail of information about any individual that would be wanted from the register, which would probably vary for different types of individuals, and the ways in which register information would be likely to be used. The Panel recommends that defense agencies be asked to study these matters and to advise the Foundation.

3. *The Panel recommends that all reasonable efforts be made to get the present data in usable form.*

Although much of the data are of reduced value now, analysis of the 1954 and 1956 questionnaires will be of historical interest and will help to determine trends.

4. *The Panel recommends that all reasonable efforts be made to bring the data on present registrants up to date.*

"Up to date" means accurate current addresses, deletion from the register of deceased registrants, addition of potential registrants who have become eligible since the initial data collection, and the correction of major items of information, such as position, responsibilities, degrees, and so on, that have changed since the time of initial data collection.

5. *The Panel recommends that there be no expansion of scope of services of the register until after the above recommendations have been carried out.*

In operating its other programs, we believe that the National Science Foundation itself does not now get from the register the data that it would find useful. This is equally true of Congress and the executive branch as well as educational institutions, scientific societies, and the scientific population at large. Only after the above recommendations have been carried out will there be available a usable register. After a usable register is in existence, the Foundation and other interested agencies will be in a position to assess its value and to make reasonable estimates of the value of contemplated expansions of coverage, services, and amount of information.

6. *In future register operation, the Panel recommends that much greater emphasis be placed upon speed, even if that emphasis requires some sacrifice of detail or completeness of coverage.*

In at least one instance, a cooperating society punched its own deck of cards before shipping the questionnaires to the Foundation. From the cards so punched the society has been able to obtain a considerable amount of useful and timely information. This is, of course, only one way in which the process of data collection, tabulation, and analysis can be speeded up. The Panel recommends that all feasible means of speeding up the operation be adopted. The mobilization function will be better served by having an accurate and up-to-date, even though incomplete, register than by having a complete register in which a large but unknown amount of the information is inaccurate and out of date. For the purpose of statistical studies, it will be of greater interest and value to the scientific community to have current information on a sample than to have information on the entire population that is several years out of date.

In summary, the Review Panel recommends that special efforts be made to put the already collected information into usable and up-to-date form so that the Foundation and others will have an opportunity to assess the value of an actual functioning register. The Panel further recommends that the staff of the Foundation come to agreement upon basic register policies with respect to scope and purpose. The Panel recommends that until these two steps have been

carried out, plans for extending the scope or enlarging the function of the register be held in abeyance.

IRA H. ABBOTT,
National Aeronautics and Space Administration.
HENRY A. BARTON,
American Institute of Physics.
ALBERT KAY,
Department of Defense.
MILTON O. LEE,
Federation of American Societies for Experimental Biology.
RAY W. MAYHEW,
Owens Illinois Glass Co.
HARRY A. WINNE,
General Electric Co.
DAEL WOLFLE,
AAAS, Chairman.

One member of the Panel (Lee) is strongly of the opinion that the scope of the register should be narrowed. This might be accomplished either by division of the present register into two completely separate portions, a "Register of Scientific Personnel" and a "Register of Technical Personnel," or by amendment of the act creating the NSF to eliminate "technical personnel." The first alternative would seem to be preferable at the present, since it would involve only an administrative policy and division, and would allow opportunity to determine how well a register of scientists only might serve. Determination of qualifications for inclusion as a "scientist" should be left to each of the cooperating organizations, with only a broadly guiding rule such as possession of a doctoral degree or its equivalent. Emphasis should be placed first on the "Register of Scientific Personnel," and it should be completed and made functional before much effort was directed to the "Register of Technical Personnel."

Foundation's future course

In rounding out the major details of the record, it is noted that following the introduction of H.R. 7981 by Representative Overton Brooks on June 26, 1959, the Foundation issued a public statement designed to clarify its future course in the manpower study field.

The text of this statement, released July 6, 1959, follows:

FOUNDATION ACCEPTS RESPONSIBILITY FOR PROGRAM OF NATIONAL DATA ON SCIENTIFIC AND TECHNICAL PERSONNEL

The National Science Foundation, an independent agency of the U.S. Government, announced today that at the request of the Bureau of the Budget it is accepting leadership in behalf of interested Federal agencies for establishing and maintaining a program of national information on scientific and technical personnel.

The Bureau recently circularized several interested Government agencies to learn their views as to the importance of adequate statistical information on scientific personnel; their training and utilization, compensation levels, supply and demand, and other related data. Agencies were asked to comment on the report of the Foundation, "A Program for National Information on Scientific and Technical Personnel." As a result of the agencies' replies, the Bureau asked the Foundation to take responsibility for a Federal program in this area "so that a coherent body of timely information can be built up on the supply, demand, and utilization of scientists and technical personnel."

The Bureau noted that "leadership in planning, coordinating, and analyzing information on scientific and technical personnel—and for assuring that the findings will be made public—would come from the National Science Foundation. In exercising these responsibilities, the Foundation should use the facilities of other Federal statistical agencies, where appropriate, to the fullest extent possible.

"Much of the information recommended will be produced by extending existing statistical series to identify scientists and engineers or to add items of information. Other projects will have to be initiated to meet the objectives of the program, but questions of coverage, timing, definitions, etc., should be considered in relation to the program as a whole. Existing statistical activities of a number of Government agencies are involved, especially those in the Departments of Commerce, Labor, and Health, Education, and Welfare."

The decision of the Bureau to ask the Foundation to accept responsibility for guiding development of a program of national information on scientists and engineers arose from recent recommendations of an Advisory Panel on Scientific Manpower Data Requirements, convened to develop a coordinated plan for statistics on scientists and engineers. Members of the Panel were: Philip M. Hauser (chairman), University of Chicago; Philip H. Coombs, Fund for the Advancement of Education; Henry David, National Manpower Council; Coleman R. Griffith, American Council on Education; Merriam H. Trytten, National Academy of Sciences-National Research Council; Ralph J. Watkins, Brookings Institution; and Dael Wolfle, American Association for the Advancement of Science.

The panel recommended a program of 15 projects and designated the following 3 as most urgent:

1. *Identification of scientific and technical occupations.*—Analysis of work content and job descriptions in scientific, technical, and related fields, to develop methods for identifying these occupational categories with adequate precision when conducting such surveys.

2. *Pool of scientific and technical personnel.*—A periodic survey, using appropriate sampling techniques, of organizations and agencies of all types which are employers of scientific and technical personnel, to obtain information on the numbers and characteristics of such personnel.

3. *Periodic study of the demand outlook for various categories of scientific and technical personnel in each major activity.*—The study would include analysis of (*a*) employment and production growth trends; (*b*) the changing roles of particular classes of scientific and technical personnel, to develop current estimates and forecasts of demand for such personnel by occupation and educational levels.

FINDINGS

(1) In 1950, when it established the National Science Foundation, Congress provided the Foundation with eight basic functions. Four of these were either ad hoc or general responsibilities. Four appeared to require the operation of specific continuing programs. The requirement that the Foundation—

> maintain a register of scientific and technical personnel and in other ways provide a central clearinghouse for information covering all scientific and technical personnel in the United States, including its Territories and possessions [3]—

was one of the four specific jobs which Congress directed the Foundation to undertake.

(2) It is recognized that the foregoing directive is a difficult one to satisfy. Rapid changes in the scientific world, in scholastic practices, in modes of formal training, in shifting work locales, and in the various facets of a scientist's continuing experience make the tabulation and study of such personnel a somewhat mercurial task—hard to perform with speed and accuracy. It is worthy of note that America's major scientific rival, the Soviet Union, is reported as having similar difficulties even with the Soviet system of work assignments which lends itself to registration much more readily than does our system. Information provided the committee, however, indicates that the Soviet Union—by creating the Scientific Economic Council in the U.S.S.R. Council of Ministers in February 1959, and assigning it the task of coordinating all registries of scientific workers—is giving high priority to this problem. We cannot afford to do less.

(3) It is recognized that a number of studies and reviews of the National Science Foundation's manpower programs have been or are being made, that some of these studies are on an interdepartmental basis, and that since 1953 the Foundation has had the continuing advice and help of a government-industry-professional Advisory Committee on Scientific Manpower Information. It is the committee's

[3] Supra, note 1, sec. 3(*a*) 8.

view, however, that, from the standpoint of legislative oversight, none of the critical reviews of the manpower programs has been of a nature to provide Congress with the picture it needs to assure the maintenance of an efficient register and meaningful manpower surveys.

(4) The National Science Foundation has been operating its manpower program on a conservative basis. The Foundation's officers have assured the committee that this has been necessary in order to arrive at a system, economically and practically, which will not be obsolete or insufficient by the time it is set up. Other witnesses have testified to the contrary and have implied that the Foundation is a victim of its own caution, that its manpower programs are made ineffective thereby. The committee inclines toward the latter view.

(5) The committee acknowledges that the National Science Foundation "at the request of the Bureau of the Budget" is now "accepting leadership in behalf of interested Federal agencies for establishing and maintaining a program of national information on scientific and technical personnel." The Foundation so announced on July 6, 1959.[4] The committee lauds the Foundation's decision. The committee, however, is at a loss to understand how the Foundation can "accept leadership" of a program at the instance of an executive agency when it was directed to do so by the Congress 9 years earlier. The committee is further mystified by this announcement insofar as it indicates that an entire year passed following the recommendations of the Advisory Panel [5] before the Bureau of the Budget determined to make such a request and insofar as the record discloses that the Bureau had already made a similar request in June of 1957, two years before.

(6) Testimony provided the committee by officers of the National Science Foundation clearly shows that the Foundation itself is making no claim that its manpower programs are adequate or that there is any possibility of attaining an up-to-date register as contemplated by the Congress in the immediate future.[6]

(7) The committee believes that the summary provided in the report of the Review Panel [7] is very revealing. That summary commented:

> The Review Panel recommends that special efforts be made to put the already collected information into usable and up-to-date form so that the Foundation and others will have an opportunity to assess the value of an actual functioning register. The Panel further recommends that the staff of the Foundation come to agreement upon basic register policies with respect to scope and purpose. The Panel recommends that until these two steps have been carried out, plans for extending the scope or enlarging the function of the register be held in abeyance.

Thus it is patent that the register, as viewed by the Panel in November 1958, could not then provide usable information and that the Foundation was experiencing internal disagreement over various phases of operating it. Foundation witnesses have testified that this situation is improved, but the committee has no reason to believe it has been erased.

(8) The committee admires the thrift of the National Science Foundation in operating its manpower programs on a relatively small budget and with a minimal staff. The committee has no desire to promote the unnecessary or ineffective expenditure of funds. Never-

[4] Supra, p. 15.
[5] Supra, p. 12.
[6] Scientific Manpower and Education, hearings before the Committee on Science and Astronautics, 86th Cong., 1st. sess., pp. 327-360.
[7] Supra, p. 12.

theless the committee is inclined to believe, in view of the statutory importance attached to these programs, that the Foundation's current policy of devoting less than three-tenths of 1 percent of its budget to the scientific register and only six-tenths of 1 percent to its entire manpower program suggests an unwarranted lack of emphasis in this area.

(9) From the foregoing it is apparent that Congress' 1950 directive, which requires the National Science Foundation to develop informational programs covering *all* the Nation's scientific and technical personnel has not been adequately met as of this date.

(10) Meanwhile, with the Space-Atomic Age upon us and with the need for scientific manpower growing daily, the need for a superior manpower tabulation is likewise accelerating rapidly. It must also be kept in mind that America's stature in the international community is becoming increasingly dependent upon her scientists, engineers, and technicians. Knowing who they are, where they are, and what they can do is thus becoming crucial.

Recommendations

The committee recommends:

(1) That the executive branch of the Federal Government, as a whole, lend its aid and influence to help assure that the study requested by the committee,[8] for submission by the opening of the next session of the Congress, will contain all relevant views and indicate where legislative action may be of most value.

(2) That the National Science Foundation seriously and carefully scrutinize its total mission, budget, and organizational structure to ascertain if more emphasis may not profitably be given to its scientific manpower programs.

(3) That the National Science Foundation and its advisory groups not permit themselves to be overly deterred from prompt and vigorous action by the shifting scientific scene. Events of the past decade indicate that this situation will not only continue but become more acute. The objectives of the manpower program and the means of reaching them should be decided upon forthwith, even at the risk of some mistakes, and immediate steps taken to implement the decision.

Conclusion

The committee acknowledges that in this complex matter it does not have sufficient information or background to make more specific recommendations or sponsor helpful legislation at the present time. The committee is not now critical, nor does it wish to appear so, of the conduct of the manpower programs within the administrative limitations imposed upon them. The committee does believe that the programs have been unduly slow in developing. It is the hope and intent of the committee, by its action here, to encourage and promote all appropriate Government agencies in their efforts to improve surveillance of the Nation's scientific and technical manpower.

[8] Supra, p. 2.

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Union Calendar No. 511
86th Congress, 1st Session - - - - - House Report No. 1181

PROGRESS OF ATLAS AND POLARIS MISSILES

REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS
U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS

FIRST SESSION

[No. 30]

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

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LETTER OF SUBMITTAL

COMMITTEE ON SCIENCE AND ASTRONAUTICS,
HOUSE OF REPRESENTATIVES,
Washington, D.C., September 10, 1959.

Hon. SAM RAYBURN,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the enclosed report, "Progress of Atlas and Polaris Missiles."

The report is based on hearings before the full committee. The findings and recommendations are offered to the 86th Congress for consideration.

OVERTON BROOKS, *Chairman.*

LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., August 17, 1958.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report on "Progress of Atlas and Polaris Missiles," prepared by Richard P. Hines, staff consultant, and reviewed by members of the professional staff.

The report is based on open session hearings held before the full committee on July 28 and 29, 1959.

CHARLES E. DUCANDER,
Executive Director and Chief Counsel.

Union Calendar No. 511

86TH CONGRESS, 1st Session } HOUSE OF REPRESENTATIVES { REPORT No. 1181

PROGRESS OF ATLAS AND POLARIS MISSILES

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. BROOKS of Louisiana, from the Committee on Science and Astronautics, submitted the following

REPORT

85TH CONGRESS } HOUSE OF REPRESENTATIVES { REPORT
2d Session } { No. 1181

PROGRESS OF ATLAS AND POLARIS MISSILES

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PROGRESS OF ATLAS AND POLARIS MISSILES

INTRODUCTION

On July 28 and 29, 1959, the committee held open hearings on the progress of research and development programs leading to the placing in operational status of the Atlas and Polaris ballistic missiles. The hearings were prompted by the disturbing fact that both missile projects had apparently experienced a number of flight failures, following many successful test flights, that might indicate the rockets were not nearly as ready for transfer to the operating forces as had been previously indicated to Congress and the American people. Hence, it was the view of the committee, as stated by the chairman, that—

> This committee has a responsibility to search out the facts and determine whenever possible the causes of recent flight failures and what is being done to correct these failures. Actually, we are as much concerned with the effect that these failures may have on the man-in-space program as the effect on the vehicle's operational use in the armed services.
>
> As long as the Atlas and Polaris missiles continue in a research phase, I believe this committee has a duty to follow up on the successes and failures.

The committee heard testimony from Lt. Gen. Bernard A. Schriever, USAF, Commander of the Air Research and Development Command and lately Commander of the Air Force Ballistic Missile Division, who testified July 28, 1959, on the Atlas program, and from Rear Adm. W. F. Raborn, USN, Director of Special Projects, who is responsible for the Polaris program and who appeared on July 29, 1959.

THE ATLAS PROGRAM

The top-priority research and development effort leading to an Air Force ICBM capability, exemplified by the Atlas, had its beginning in February 1954, with the issuance of the report of the Von Neuman committee, which urged the initiation of such a program at the earliest possible date. In 1954, the major subsystems of an ICBM did not exist—no reentry nose cone, no suitable engine, no guidance—but the eminent scientists of the Von Neuman committee had no doubt that such a weapon system was feasible and could be achieved soon enough vis-a-vis the Soviet development program, to become one of the major deterrent forces against the aggressive military threat of the Soviet Union.

As it has evolved, the Atlas has become a vehicle of great importance not only to our national defense but also to our satellite and man-in-space projects. It is a liquid-fueled rocket employing liquid oxygen and kerosene (JRP) as propellants. To give some idea of its dimensions, it has three engines (two boosters and one sustainer), delivering approximately 360,000 pounds of thrust to lift about 250,000

pounds at lift-off. It employs an inertial guidance system, and has one and a half stages—that is, separation involves only the booster engines and not tankage—stands about 80 feet high and measures about 10 feet in diameter.

Four model types of the Atlas have been used in the test program. The first, series A, was fired with only the booster engines operating to test the propulsion structure, auto pilot, and telemetry systems. The B series was the first type used to test the complete missile—the guidance, separation of boosters and nose cone. The C differed from the others in that its metal skin was significantly thinner, thereby saving weight. The D series, the operational missile, differs from the previous series by a simplification of the systems design relating to the engine.

At the time of General Schriever's testimony, 26 Atlases—less than half the number scheduled in the program—had been fired, and of that total, 11 had been completely successful in that they had achieved within established tolerances all planned objectives. However, included in the 15 so-called failures, were the recent 5 successive mishaps that had aroused the concern of this committee. Three of those "failures" had been due to causes that have been determined to be unrelated. One was caused by an erroneous signal generated in the guidance system by an electronic failure. Another was caused by the failure of ground personnel to close a valve through which the missile was fueled with liquid oxygen. The third was the result of a malfunction that occurred in the launching mechanism, which in turn ruptured pressure tanks in the vehicle. The varied causes of these three unrelated failures were remedied.

The two related failures could not be determined immediately because the first, of this particular nature, occurred in missile 5C and the second in Atlas 5D, the first and fifth of the five recent failures.

A further description of these two malfunctions is not possible because of security. However, the Air Force Ballistic Missile Division believes that proper steps have been taken to prevent the recurrence of this particular difficulty.

THE POLARIS PROGRAM

One role of the Navy, as demonstrated in World War II, has been the delivery of great firepower upon enemy forces from mobile, highly flexible, and widely deployed sea forces. The design of the Polaris missile system is consistent with this concept. Although from the point of view of pure statistics the Polaris performance does not compare in any way with that of the Atlas or with the Titan insofar as range is concerned, the system, as it has been wedded to the tactical operation of surface and underwater vessels, is capable of an intercontinental ballistic missile effectiveness that incorporates many unique features.

The Polaris concept came into being about 3½ years ago, following an attempt by the Navy, in partnership with the Army, to evolve means by which the Jupiter could be adapted for Navy use. However, the nature of the Jupiter, particularly the requirement for liquid fuels, made impractical its use within the environmental limitations of shipboard operation.

Thus the Navy soon became convinced that it needed to have a missile whose propellants were shore-installed and relatively unaffected by a wide variety of conditions and which would be strong enough to withstand being handled by shipboard personnel. This conviction led directly to solid propellants, a field which, up to that time of decision, had not been given much attention as a major source of thrust for large rockets.

However, a significant breakthrough by Navy R. & D. in improving the thrust attainable with these propellants, the development by the Atomic Energy Commission of the small high-yield nuclear warhead, and the unqualified success of the atom-powered submarine, *Nautilus*, gave the Navy the major elements it needed for a practical and effective weapon system.

At the time of Admiral Raborn's testimony, 33 Polaris test vehicles had been fired. Of these, 24 were considered successful in meeting the test objectives, 7 were partially successful, and 2 were failures, although contributing valuable information.

PROGRESS OF THE PROGRAMS

In evaluating the success of the Atlas and Polaris research and development programs, as demonstrated by the missile launchings, it is necessary to establish by definition what constitutes a missile failure.

In essence, a rocket firing is the culmination of a multitude of operations beginning at the contractor's plant and ending at the launch complex after hours and days of meticulous preparation. A test vehicle firing is analogous to a difficult laboratory experiment in which many known elements are combined with a few significant unknowns and are then subjected to energy to produce a reaction from which information can be derived. Hence, the proper definition of a flight failure would be one from which no new information could be obtained.

In the light of this, the Air Force and the Navy have had really very few total failures in their flight tests of the Atlas and the Polaris, even though both programs have had many vehicles destroyed by the range safety officer at Cape Canaveral. In almost every case, some valuable information has been obtained that has moved the program closer to the overall objective of placing the weapon system in operational status at the earliest possible time. However, it would be unrealistic to infer that the abortive attempts were equal in achievement to the completely successful flights and that the people responsible for the tests were satisfied with those partial and often meager results.

As to timetable, the most significant testimony by General Schriever revealed that Atlas would be considered operational in September of this year. As General Schriever stated in his testimony:

> My deep confidence in the Atlas program is not based solely on the flight test program. Flight tests are the spectacular result of a vast orderly test program which begins long before in laboratories, on environmental test stands, on acceleration sled runs, on captive engine test stands. Early in the development program thousands upon thousands of tests are performed to demonstrate the adequacy of components, of subassemblies and then assemblies, of subsystems and then of systems, and finally of the entire missile. Valid estimates of ultimate missile

reliability can only result from an analysis of the sum total of all this testing data. Based on such analysis, we have good reason to believe that we will achieve our operational reliability objectives.

* * * In order to place the Atlas program in the clearest possible perspective of a short 5 years of history, we must look at other aspects of the program. We are providing not only the operational missile but have also carried out many planning, management, and implementation activities essential to the operational capability. Concurrent, on-schedule provision has been made for trained personnel, for logistics and spare parts, for communications, for operational bases, and for a ground support environment of unprecedented complexity and magnitude. All of this has been done according to a very tight schedule which was established over 4 years ago. At the same time we have been able to introduce highly significant improvements of later Atlas operational capabilities which were not even considered as we laid out those original schedules. I refer to such improvements as the all inertial guidance, the ablation reentry vehicle, warheads of increased yield and hardening and dispersing of launch sites.

* * * I might say that we have been proceeding in all the other phases of the program, the establishment of the operational environment, the training of personnel, the production of the missiles. We have continued right on schedule in the Atlas program and. assuming we have found the fix on the Atlas and we have a rather accelerated flight test program during the next 5 weeks which will determine for sure whether we have, then we should have the beginnings of our operational capability about 60 days behind what we had originally hoped for.

The Air Force is approaching a degree of reliability in the Atlas that is well within the acceptable limitations of the testing schedule, a fact that is most important not only to our ICBM offense capability but also to NASA's man-in-space program which will employ the Atlas as a first-stage booster.

The Navy program, beginning with a scheduled operational date of 1965, has been able to compress its timetable by reason of its successful achievement in its research test programs to promise delivery of an operational system by 1960. To quote Admiral Raborn:

We will be operational toward the end of 1960, calendar year 1960. This (the operational date) is a goal which has been twice accelerated. We started out to bring this system into being by 1965. At specific requests of the Government, we accelerated it to 1963.

This date was advanced from 1963 to about 1960. These accelerations were made possible by the substantial progress in systems development, coupled with a few major breakthroughs. Had not our development program been so successfully productive, it would not have been possible to respond to requests for our best possible schedule.

We have had two major breakthroughs during the missile development: one contributed by the AEC and the other a Navy achievement in the field of solid propellant fuels. The tests to date have provided verification of basic design decisions, but further substantiation is necessary to fulfill our reliability requirements for a seaborne missile. We have had no serious setback of a technical nature in terms of the basic design of the missile. We have obtained a feedback of information on the types of necessary adjustments we expected to find out through these tests, and I am happy that they are becoming known to us in the early stages of our present flight test vehicle program so that solution can be tested and proved well in advance of our 1960 target operational date. I repeat, we have uncovered no situations calling for changes beyond the engineering refinements normally expected in developing any new and complex mechanical, chemical, and electronic device. We require no further breakthroughs.

Both General Schriever and Admiral Raborn stated without qualification that progress and success of their programs exceeded the original estimates. For instance, the Von Neuman committee stated that it would take 6 to 8 years for the Air Force to produce a reliable system. But the Air Force, at the beginning of the Atlas testing 4 years ago, established a very tight schedule that called for operational reliability by July of 1959. This date has been extended to September

1959 because of the need for additional tests caused by the recent difficulties.

CONCLUSIONS

Although the committee hearings were quickly scheduled and necessarily short, careful interrogation by the members brought to light important facts pertaining to the progress of research and development in the Atlas and Polaris programs. In sum, the hearings showed that—

(*a*) Despite the widespread publicity of abortive missile flights that occurred during the recent weeks, the fact is that both projects are progressing at a highly satisfactory rate and that there is no doubt in either the Air Force or the Navy that their respective missiles will be operational on or about their scheduled dates.

(*b*) There is a great disparity between the popular and the scientific concept of what constitutes a "missile failure." With few exceptions, almost every missile test flight, whether it flies perfectly or is destroyed only seconds away from the launch pad, provides extremely valuable information that is indispensible to the progress of the testing program and the improvement of the missiles. It therefore becomes clear that in reality both the Air Force and the Navy have had very few abortive flights that could be classified as complete "failures," and that *none* of the less-than-completely successful launches has compromised either testing program.

(*c*) Both the Air Force and the Navy have achieved an outstanding record in the planning, organization, and management of their respective research and development missile programs. Despite all the possible vicissitudes inherent in testing such rockets, the Air Force has suffered only a 60-day slippage in a 4-year testing schedule, and the Navy, after compressing the original Polaris timetable by 5 years, is highly confident of placing in operational status a working missile system on the scheduled date.

It is the belief of the committee that the Congress and the American people can be assured the development of our ICBM strength has suffered no real setback by recent events, and can confidently expect that each new objective achieved by our rocket programs will be an additional guarantee for peace and our future security.

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Union Calendar No. 512
86th Congress, 1st Session - - - - - - House Report No. 1182

BASIC SCIENTIFIC AND ASTRONAUTIC RESEARCH IN THE DEPARTMENT OF DEFENSE

A REPORT

OF THE

COMMITTEE ON SCIENCE AND ASTRONAUTICS

AND SUBCOMMITTEES NOS. 1, 2, 3, AND 4

U.S. HOUSE OF REPRESENTATIVES

EIGHTY-SIXTH CONGRESS

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[No. 31]

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

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The chairman of the full committee and the ranking minority member, the Honorable Joseph W. Martin, Jr., are ex officio members of all subcommittees.

LETTER OF SUBMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., September 11, 1959.

Hon. SAM RAYBURN,
Speaker of the House of Representatives,
Washington, D.C.

DEAR MR. SPEAKER: By direction of the Committee on Science and Astronautics, I submit the enclosed report, "Basic Scientific and Astronautic Research in the Department of Defense."

This report has been prepared following hearings by both the full committee and by four subcommittees as identified herein. It represents a very thorough review of these important scientific programs of our largest department of Government.

The findings and recommendations of the report are earnestly offered to the 86th Congress for consideration.

OVERTON BROOKS, *Chairman.*

LETTER OF TRANSMITTAL

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND ASTRONAUTICS,
Washington, D.C., August 21, 1959.

Hon. OVERTON BROOKS,
Chairman, Committee on Science and Astronautics.

DEAR MR. CHAIRMAN: I am forwarding herewith for committee consideration a report on "Basic Scientific and Astronautic Research in the Department of Defense." The sections on the Office of the Secretary of Defense and the Air Force were prepared by Richard P. Hines, staff consultant; the section on the Navy was prepared by Spencer M. Beresford, special counsel; the section on the Army was prepared by Philip B. Yeager, special consultant; and the section on the Advanced Research Projects Agency was prepared by John A. Carstarphen, Jr., counsel. Dr. Charles S. Sheldon II, technical director, supplied coordination and editorial review.

This report is based on testimony obtained in both open and executive session hearings before the full committee and also before four subcommittees. The full committee in three sessions heard witnesses from the Office of the Secretary of Defense. Subcommittee No. 1 (Representative George P. Miller, chairman) held one session with the Advanced Research Projects Agency. Subcommittee No. 2 (Representative Olin E. Teague, chairman) held three sessions with the Army. Subcommittee No. 3 (Representative Victor L. Anfuso, chairman) held four sessions with the Navy. Subcommittee No. 4 (Representative B. F. Sisk, chairman) held two sessions with the Air Force. The resulting consolidated report summarizes highlights of the testimony, and offers conclusions and recommendations which flow from the committee's studies.

CHARLES F. DUCANDER,
Executive Director and Chief Counsel.

Union Calendar No. 512

86TH CONGRESS, 1st Session } HOUSE OF REPRESENTATIVES { REPORT No. 1182

BASIC SCIENTIFIC AND ASTRONAUTIC RESEARCH IN THE DEPARTMENT OF DEFENSE

SEPTEMBER 11, 1959.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. BROOKS of Louisiana, from the Committee on Science and Astronautics, submitted the following

REPORT

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BASIC SCIENTIFIC AND ASTRONAUTIC RESEARCH IN THE DEPARTMENT OF DEFENSE

I. Office of the Secretary of Defense

INTRODUCTION

Since the beginning of the 86th Congress, the Committee on Science and Astronautics has conducted an extensive and comprehensive inquiry into research and development activities conducted by the Federal Government. This is in keeping with the committee's responsibility for congressional interest in scientific research, so vital to the national welfare.

On June 4, 1959, and June 8, 1959, testimony was received respectively from Dr. Herbert F. York, Director of Defense Research and Engineering for the Department of Defense; and Wilfred J. McNeil, Assistant Secretary of Defense (Comptroller), on research and development as it is directed and managed for the military services and the Advanced Research Projects Agency (ARPA) by the Department of Defense.

ORGANIZATION—MANAGEMENT

The establishment on February 10, 1959, of the Office of Director of Defense Research and Engineering centralized the supervision and executive management of all research and development programs in the Department of Defense including the armed services.

As the President stated to Congress last year, in submitting the plan for reorganization of the Department of Defense, the Director was to be the principal adviser to the Secretary of Defense on scientific and technical matters, to supervise all research and engineering (development) activities in the Department of Defense, including those of ARPA, and the Office of Guided Missiles, and to direct research and engineering activities that require centralized management.

In monetary terms, this involves the expenditure in fiscal year 1960 of almost $6 billion, an unprecedented task of monumental proportions involving about 2,000 distinct projects incorporating many thousand separate subprograms.

Such statistics serve, if nothing else, to highlight the complex problem of selection—that is, making the necessary decisions with regard to what projects are to be funded and pursued. Fortunately, the research phases are the least expensive part of any project, and thus such decisions need not necessarily be critical. It is primarily when the development stages are approached, involving the ever-increasing cost of materials and services that the projects are carefully screened and reviewed for their significance to the national defense.

The general management of thousand of projects requires a continuous flow of information between the Director of Defense Research

and Engineering and the responsible DOD agencies to provide the means by which day-to-day decisions can be made. At present there is a staff of 116 professional people who incorporate the widest practicable spread of talent in scientific and operational fields. It is this group which, by means of constant communication with the responsible services and visits to operating installations, amasses the information upon which selectivity and decision can be exercised at the DOD level.

In accordance with the fiscal year 1960 budget, the Director's areas of responsibility have been broken down into the following categories:

Military services.
Aircraft and related equipment.
Missiles and related equipment.
Military astronautics and related equipment.
Ships and small craft and related equipment.
Ordnance, combat vehicles, and related equipment.
Other equipment.

These categories in turn are program areas of the individual services as appropriate to their missions. In addition, the Director is responsible for items of development, test, and evaluation that are currently included in the procurement appropriation by the Navy and Air Force. A few of the items include the Navy's Polaris, Corvus, and Eagle missiles, aircraft engines, combat vehicles, and related equipment. For the Air Force, there are the B–70, F–108, B–58, and the Titan, Atlas, Minuteman, and Bomarc missiles.

Coordination with research and engineering activities conducted by other Government agencies is continuously maintained. For instance, close liaison is maintained with the Atomic Energy Commission with regard to work in nuclear development which contains promise of practical military application.

Coordination is also maintained with the Department of Interior; Department of Health, Education, and Welfare; Federal Aviation Agency; National Bureau of Standards; National Science Foundation; and Federal Maritime Board, on current research being conducted by these organizations which is of interest and use to the Department of Defense.

BUDGET

The fiscal year 1960 Defense Department budget calls for an expenditure of $3.7 billion for specific items listed under research and development. However, this figure does not include many expenditures that are directly related to research and development. For instance, items carried under procurement appropriations amount to $1.8 billion. Furthermore, many items are carried under military construction appropriations, such as the construction of research, development, test, and supporting facilities—buildings, rocket launch complexes, etc.—that are the responsibility of the Director of Defense Research and Engineering and must be included in the appropriated funds. Actual expenditures will total about $6 billion, compared with about $3.5 billion in 1955—an increase of $2.5 billion in 5 years.

Procurement and military construction appropriations are necessarily coordinated with those for research and development. As stated by Secretary McNeil—

> Except for such areas as basic and applied research, technical developments, and the cost of supporting and operating the Defense Department's own laboratories and test facilities, the balance of the R.D.T. & E. program represents development effort largely influenced by basic decisions made on the major weapon systems.
>
> In other words, the R.D.T. & E. program is an integral and inseparable part of the total defense program. All the factors and considerations which influence the total defense program also influence the research, development, test, and evaluation activity.

It is apparent that the R.D.T. & E. program must perform two vital functions for our Armed Forces. It first must provide the DOD planners with the necessary technical information for deciding upon the most practical course of action for future weapon systems, and secondly, provide the means by which these decisions can be brought to reality. As stated recently by Secretary McElroy—

> We are faced with the necessity of making decisions among various alternatives—in other words, of exercising judgment * * * In doing so, we must make use of the best military and scientific talents in the country. Through this process we have formulated the defense program and budget for fiscal year 1960.

Many factors that influenced the development of the fiscal year 1960 Defense Department budget have a direct effect upon the R.D.T. & E. programs, particularly with reference to the varied emphasis to be placed on current projects, and the establishment of new ones. For instance, the strengths and weaknesses of potential enemies play a major part in deciding what programs to accelerate or to reduce. Also the strengths and weaknesses of our allies are extremely significant in view of the influence which economics, both in our own country and abroad, will play in determining the possible material contributions of our allies to our collective strength.

CONCLUSION

Wars have generally been won by nations with superior weapons, properly employed. This has been true from the days of the Caesars and the Roman short sword down to Patton and his encircling, swift-thrusting tanks.

It is equally certain that the development of superior weaponry does not often occur by accident or good luck. It results from long theoretical and empirical effort.

The rapid expansion of technical knowledge in our century has led to the creation of a research and development organization in our Defense Establishment that is charged with the responsibility for providing to our Armed Forces the most potent and effective weapons and weapon systems it is possible to devise at reasonable cost. The effectiveness of our deterrent forces depends on our national scientific and engineering effort. And the principle that eternal vigilance is the price of freedom is nowhere more true than in our research and development organizations, which must keep constantly aware of new scientific advances and be quick to utilize them for our defense.

Early this year, Secretary of Defense McElroy took steps to insure that the research and development effort of the Defense Establishment will continue to be progressive and dynamic. As he testified before the committee on March 2, 1959:

> As you know, one of the most important objectives of the recent reorganization of the Defense Department was to insure that our research and engineering activities would have the integrated direction and leadership needed for our national security, now and in the future. To this end a new position was created, that of Director of Defense Research and Engineering, and Dr. Herbert F. York has since been appointed to fill that position. The Director of Defense Research and Engineering is my principal adviser on scientific and technical matters and is responsible for the supervision of all research and engineering activities in the Defense Department.
>
> The interrelationship of the Director's activities with those of other elements of the Department of Defense can best be understood if we look at the whole operation. There are four basic operating research and engineering agencies in the Department of Defense: Army, Navy, Air Force, and the Advanced Research Projects Agency. These agencies do research and engineering of a varied nature consistent with their assigned duties. The research they undertake may be done within their own facilities or by contract with outside sources, depending on which in their judgment will produce the best results. The function of the Director of Defense Research and Engineering is to supervise and coordinate all research and engineering, regardless of what element of the Department of Defense does the work or the nature of the work undertaken.
>
> I look to the Director to provide the dynamic leadership which will see that our research and engineering programs are far reaching and imaginative, move forward without unnecessary duplication, and *represent an optimum integrated program to meet the requirements of national military objectives.*

The interest of this committee in the research and development operations of the Department of Defense and also of all other agencies of the Federal Government is motivated by the deep conviction that the greatest resource and strength of the American people and the Nation lie in the ability to translate new ideas, new concepts, and new developments into reality through proper organization and the application of sufficient resources.

II. Advanced Research Projects Agency

(Subcommittee No. 1)

Subcommittee No. 1 heard witnesses from the Advanced Research Projects Agency in research and engineering hearings, Wednesday, June 9, 1959. The subcommittee heard Mr. William H. Godel, Director, Policy and Planning, and Mr. George P. Sutton, Chief Scientist, on the more recent developments in the field of research and development, not only in the technological developments of the military but also on the economic ramifications of peaceful civilian scope of the space technological achievements.

ARPA has the responsibility of centralized management at the highest level and it was created to avoid unnecessary duplication and to establish the high priority called for in the highly specialized and extremely costly job of space research and development. This responsibility can be exercised effectively and economically only by selecting with utmost care the extremely high-cost programs and projects so as to make maximum use, not only of the time element involved, but also of the supply of technical talent, material resources, and funds required to achieve the ultimate goal.

At the present time ARPA has under contract approximately 40 scientific personnel. ARPA has been assigned expanded functions in the field of missile defense, and it is felt that presently there are insufficient scientific personnel under contract to do properly the job assigned the Agency. This "tight personnel" problem is, it is felt, only temporary in that the tasks assigned by the Secretary of Defense had been expanded immediately preceding the hearings held on June 9. Administrative and secretarial help presently assigned to ARPA are approximately 30 in number. ARPA is an organizational entity in the defense setup which specializes in resolving a particular problem and in reducing the unknowns in the research and development area to proportions that would enable the Secretary of Defense to assign the problem to one of the defnse agencies which, in turn, will be charged with the problem of placing into operation ARPA's development.

ARPA is charged with the management of research and development in the following three areas: (1) Military space technology, (2) ballistic missile research, and (3) solid propellant technology.

In order to solve the problems arising under the three broad project areas, ARPA uses five different types of research and development effort. These are as follows: (*a*) Fundamental research, (*b*) applied research, (*c*) development of critical components, (*d*) system feasibility demonstration experiments, and (*e*) systems studies.

Stated simply, fundamental research (otherwise known as basic research) is an effort to reach a goal which is beyond the limits of present human knowledge. It is the expectation of discovering something new in knowledge, concept, or principle which will lead to a better understanding of what is going on in the area researched.

ARPA feels that this category is the most interesting of the five referred to above and is by and large more fundamental to the true concept and purpose of ARPA than perhaps any of the remaining fields. Some interesting examples of work done in this category are in high-temperature thermochemistry. These studies are in the main theoretical studies of the properties of chemical compounds suitable for rocket propellants, and are being conducted by ARPA at the University of Chicago, Ohio State University, Vanderbilt, and the University of Wisconsin.

Many of the projects being conducted are of purely experimental nature with the expected hope that they will produce new approaches which, in turn, could be used to measure new synthetically formed chemicals which may be proved suitable for rocket propulsion.

ARPA is also sponsoring some research on photosensitive materials for photovoltaic cells which eventually will be used for converting solar energy into usable form. They are also working on certain cheap organic materials for this purpose. ARPA is presently supporting the development of a special hypersonic blowdown tunnel which will be capable of going to Mach 15 for durations as long, perhaps, as 20 seconds. This, of course, is much longer in duration that conventional hypersonic tunnels and will therefore permit the evaluation of reentry physical phenomena. This work is being done at Cornell Aeronautical Laboratory and should give air stagnation temperature above 8,000° F. and perhaps as high as 14,000° F. by the use of lightweight gases.

In the applied research area, ARPA has a number of contracts, each concerning a different approach to the creation of better solid propellants. It is presently accepted by chemists that solid propellants can be improved in present performances by approximately 20 percent. Such performance is essential in order to double the payload capacity of certain missiles, and certainly is required if solid propellants are to become more suitable for space flight and missile missions.

In the field of applied research, ARPA has contracted for certain studies to investigate the heat rejection mechanisms in space-borne radiators. This includes the effect on special surface coatings and the mechanism of condensing vapors in a vacuum as well as the effects of radiator geometry and orientation.

In the third category, the development of components, fall the contracts for design and construction of experimental pieces of hardware which, if proved effective, can at a later date become an integral part of the flying units of already established basic principles. In this category come various radiator devices, components of various plasma-type propulsion systems, and the development of systems used in electrostatic or electromagnetic fields which are used to accelerate the ionized fluid of plasma.

In the system feasibility type of research is found the test of various components of an experimental system which demonstrates that they are properly matched to accomplish the desired result. For example, in a delayed repeater communication satellite system there are several ground tracking stations, a number of ground repeaters and transmitters, satellite-borne repeaters, transmitters, power supplies, information storage devices, signaling devices, guidance systems, and even orbital correction devices. Obviously all of these must func-

tion in proper sequence at the required time and in such manner that one component will not prejudice the behavior or prevent the performance of another component. In this category of research ARPA requires contracts necessary to perform experiments with the complete systems, and very often these experiments are made with interim hardware that contains the basic concept but not the final design variations. The systems studies type of research and development is often carried on simultaneously with component development work.

A complete military system is extremely expensive. Systems studies are conducted in order to assist with the selection and to eliminate work that may no longer be of interest. In this category falls the conducting of studies comparing various types of space-borne power supply systems, studies of satellite communication systems, radar acquisition systems, and data and decision-making systems.

III. Army

(Subcommittee No. 2)

Subcommittee No. 2 was assigned the responsibility of inquiring into the broad research and development program being conducted by the Department of the Army with two objectives in view.

One of these was to acquaint a nucleus of the full Committee on Science and Astronautics with the details and problems of the Army's segment of defense research. The second was to pinpoint any particular difficulties being encountered by the Army in its research and development program and bring them to the attention of the full committee with such recommendations as might appear warranted.

The subcommittee met a number of times during June and July in both executive and open session.

It received testimony from the best qualified witnesses available. These included the following:

Lt. Gen. Arthur G. Trudeau, Chief of Research and Development, Department of the Army.

Maj. Gen. William W. Dick, Jr., Director, Special Weapons, Department of the Army.

Brig. Gen. Frank H. Britton, Director of Development, Department of the Army.

Brig. Gen. William T. Ely, Director of Research, Department of the Army.

Dr. Per K. Frolich, Chief Scientist, Chemical Corps, U.S. Army.

Dr. Roy B. Power, Chief Scientist, Department of Ordnance' U.S. Army.

Dr. Ralph G. H. Siu, Chief Scientist, Quartermaster Corps, U.S. Army.

In addition to the foregoing, the subcommittee received testimony and demonstrations from a number of backup witnesses who were also made available by the Army on request.

GROUND COVERED

These witnesses covered the entire research and development area in which the Army is engaged. This included the programs being carried on by the Medical Service, Chemical Corps, Corps of Engineers, Ordnance Corps, Quartermaster Corps, Signal Corps, Transportation Corps, and special weapons such as missiles and rockets.

It was apparent that the Army feels a particular urgency in connection with its overall research and development—an urgency described by General Trudeau in these words:

> The need for * * * our research and development programs is highlighted by the quantum jump for offensive combat that has been forced on us by the advent of the intercontinental ballistic missile and the intermediate range ballistic missile * * *. By a quantum jump we mean a very

substantial advance or breakthrough over an existing weapon system or piece of material, and this is in contrast to what we call product improvement.

When this factor is viewed alongside the basic trend termed by General Ely as "the explosion of science" since the Korean war, it is not surprising that the Army considers itself a most likely candidate to be overextended in any future conflict—unless it can meet innovation with innovation through an accelerated research and development program.

A summary of what the Army contemplates in the months immediately ahead was provided by General Trudeau as follows:

I would like to outline the areas of interest of our research and development effort for the coming year. First, the Army gives extensive support to the National Aeronautics and Space Administration and to the Advanced Research Projects Agency. Many of the satellite programs of these new agencies will give direct support to Army requirements in mapping, communications, meteorological data, surveillance, and navigation. We are proud of our repeatedly demonstrated capabilities in the field of missile and space exploration. Our extensive scientific capabilities in this field should be fully exploited for the good of the Nation.

Next I would like to discuss the very important combat aspects of mobility, communications and battlefield surveillance, firepower, and logistical support which will make for the most effective and coordinated use of our future capabilities.

On improved mobility for our forces, we are gearing our programs to the concept of the pentomic battlefield where wide troop dispersion is required. We are seeking real offroad capabilities for our land vehicles since the Army has to be prepared to fight over all the varied terrains of this earth and not on the paved roads of America. We are making substantial progress with our wheeled and track vehicles in this regard but more needs to be done. In the air, we need aircraft that fly low and slow above the "nap" of the earth. Not only do we want to hug the earth with these aircraft but we must navigate over the terrain as quietly as possible.

This program in aircraft research is now beginning to have more impact. We have many types of flying vehicles in various stages of development. What we want is an aircraft that has the vertical takeoff and landing characteristics of the helicopter coupled with the characteristics of a fixed wing aircraft in forward flight. There is such a concept now under development.

In the field of communications and combat surveillance which includes electronics, we find great technical advances being made. It is here that we are striving to match the requirements of the dispersed battlefield as well as the intelligence requirements to rapidly locate targets for our new missile weapons and the others that are to follow. Electronics in general has seen a tenfold increase since World

War II and another tenfold increase can be expected by 1970. This is the fantastic area of development where the old vacuum tube circuits are now being microminiaturized to one-tenth, one-hundredth, and even one-thousandth of their original size and volume. This will be a tremendous savings in bulk and weight and in power requirements for an across-the-board application to all types of Army equipment.

In the field of combat surveillance we now have better photographic, radar, infrared, and television means under development to survey the battlefield and assist in location of enemy targets. Our aircraft drone program will give the Army commander a capability of surveillance for hundreds of miles forward of the most advanced combat units.

I would like to mention here the importance of the various laboratories of the technical services. These facilities are spread all over our Nation and contribute substantially to civilian programs as well as to the military. As an example, our electronic warfare center at Fort Huachuca in Arizona, has already contributed an untold amount of knowledge to the electronics industry. And speaking of these laboratories, some of which are located in our arsenals, I would like to emphasize that most of the work centered there is accomplished by industry, private research institutions, and educational organizations which have contracts with the arsenal and the technical services concerned. As an example, the Ordnance Corps at Redstone Arsenal in Alabama spends most of its ballistic missile and space money outside the arsenal. Only 12 percent of those funds are expended on inhouse effort.

In the area of firepower, the development of weapon systems today is so rapid that it is hard to envision what lies ahead between now and the turn of the century. While the horse and lance remained important weapons of warfare for more than 2,000 years, the manned airplane as a weapon of war may last less than 100 years because of the advances in missilery. The heavier weapons of today are rapidly seeing transition from the kinetic energy shell of artillery cannon and weapons of all calibers, to rockets and missiles of varying types and ranges capable of projecting warheads of conventional chemical, or nuclear types with great accuracy for hundreds of yards or miles. The advance of scientific knowledge is already resulting in the obsolescence and obsoleteness of missiles considered the most advanced in the world only a short 5 years ago. The Army is attempting to keep the number of its new missile systems as small as possible in the interest of simplicity and economy. However, each missile we are developing has a definite and specific mission to support our combat plans. * * *

I mentioned that the subject of logistics is very vital to our battlefield concepts of the future. We are concerned with logistics as it applies to the strategic movement of Army forces in long-range troop aircraft as well as to the troop ships that move over the seas. There is much to be done in both of these areas if we are to have the strategically mobile forces that are required for the limited conflicts that

at best are likely to continue to flare up along the perimeter of the Communist borders.

PERSONNEL INVOLVED

In carrying out its research and development programs the Army presently employs a total of 29,304 persons directly. Of these 19,369 are civilian employees and 9,935 are military personnel. Their programs are carried on in 38 different establishments throughout the United States, plus research offices in Germany and Japan.

In addition, of course, a very large part of the Army's research and development program is carried on by contract with private firms and institutions. For example, in basic research the Army's programs extend to 123 colleges and universities, plus industry, in 10 major fields and 74 subfields ranging from human engineering to arctic and polar research.

PROBLEMS FACED BY THE ARMY

While the subcommittee was provided with considerable information on specific hardware and weapons being developed by or for the Army, it did not conceive of its mission as including an evaluation of weapons, tactics, or operations. Hence the subcommittee did not inquire directly into the justification for any particular military concept or weapons system.

The subcommittee's inquiry did, however, bring to light certain internal problems which the Army faces in its research and development program. These appear to lie in four general areas, as follows:

(1) *Overcoming lengthy leadtimes.*—It was testified that the average leadtime, conception to operation, of a weapon or weapons system in the United States runs from 8 to 10 years. By way of comparison, the leadtime for comparable Soviet programs is thought to be from 4 to 5 years.

(2) *Securing adequate and timely funding.*—As with all effective research programs, it is essential to have dependable and consistent means for pursuing them. This means an adequate amount of money guaranteed for the entire research period. Otherwise, the resulting stop-and-go procedure results in considerable loss of time and progress as well as wasted funds.

(3) *Streamlining research management.*—A number of witnesses have pointed out from time to time that within the Defense Establishment only a few have the power to say "Yes" to a given research and development project, while many have authority to say "No." There are many decision levels to be overcome. While this may be a useful and economic procedure in many areas of Government, it is a dangerous one in the field of research and development where a high degree of vision and imagination is essential. Unfortunately, many of those with the power of veto over research and development projects do not have the training or foresight necessary to recognize the ultimate potential of these projects.

(4) *Obtaining scientific information.*—The interchange of scientific information resulting from specific research projects within the armed services themselves appears to be reasonably good. It is also believed to be improving, so that each service is becoming better aware of

what the others are up to. On the other hand, scientific information developing outside military contract areas and in foreign countries is neither comprehensive, properly capsuled, nor adequately disseminated. This informational bottleneck is costly to military research and development in terms of opportunities missed and unnecessary duplication of effort.

RESEARCH AND DEVELOPMENT FUNDS

The extent of the Army's dependence on research and development is well illustrated by the fact that it is spending roughly 10 percent of its entire budget for fiscal 1960 in this area.

Initially the Army requested $1,302 million for its various research and development programs. This amount was reduced to $1,046 million through normal administration budgetary procedures and to $1,035 million by the Congress.

The Army thus lost $267 million from its contemplated research and development expenditures, or about 21 percent of the original request.

It should be noted that the money which the Army includes in this category is for "research, development, test, and evaluation." Of the total appropriation, the Army plans to spend only $90 million on basic and applied research—which is less than 9 percent of the funds available—although another $60 million not included in this category will be spent indirectly on "supporting research" for a variety of Army activities. In any event, it appears that about 90 percent of the Army's research activities will actually go into test and evaluation.

FINDINGS

As a result of its inquiry into the research and development program of the Army, the subcommittee finds that the progress being made is impressive within the limits imposed by funds, equipment, available personnel, and high-level planning.

Apart from this general observation, the subcommittee has reached the following conclusions:

(1) The Army, perhaps even more than its sister services, must depend on a comprehensive research and development program to remain effective in combat situations, whether these are global or local. This is because traditional concepts of land warfare have changed very rapidly since World War II and are continuing to change. While it may be expected that the most probable active use of the Army in the foreseeable future would be in regard to the so-called brushfire war, the Army must nonetheless depend on extensive new techniques and systems inasmuch as it is almost certain to be far outweighed in terms of the opposition's manpower.

(2) Budgetwise the Army research and development program is, at present, just barely "getting by." It is significant that General Trudeau feels that the Army is not prosecuting more than half of the possible research areas which might be of genuine utility to the Army. It is also significant that, when the subcommittee pressed the point, General Dick admitted that budget conditions imposed upon him for the coming year are "considerably tighter" than they have been in the past.

(3) In view of the swift scientific pace going forward today, research and development money clearly seems inadequate. This is the case, apparently, at all levels of military government. The amount allocated for research within the total administration budget appears inadequate; the amount allocated to the Army within the Defense Department budget appears inadequate; and the amount allocated by the Army within its own budget may also be inadequate in view of its dependence on research and development. In making this observation the subcommittee is not attempting to substitute its judgment for that of the Defense Establishment in the latter's use of available funds. The subcommittee is merely noting a general condition of fiscal anemia which appears to afflict Army research and development.

(4) The amount of research and development money actually being expended by the Army on basic and applied research, as distinguished from its developmental, test, and evaluation activities, appears to be very low.

(5) In its efforts to reduce the leadtime necessary for the development of new weapons and weapons systems, the Army (as well as other services) is definitely handicapped by a multiplicity of decision levels and by bureaucratic contract procedures which, while designed to assure economy and democratic fairness, are often excessively time consuming.

(6) The total Army research and development program is handicapped by insufficient liaison with similar foreign programs and with talented foreign scientists who may already have uncovered scientific information which the Army is still seeking. Conversely, the Army, as well as the other services, is often handicapped through the advantage given Iron Curtain countries by rapid publication of U.S. scientific breakthroughs.

(7) Although the Army has no space program per se, it has specific interests in space which warrant vigorous and expeditious research in such allied areas as the use of space or space vehicles for communications, weather interpretation, surveillance, reconnaissance and the like.

(8) Because the actual capability of all services to use space is still in its formative stages and because so many scientific answers in relations thereto are unknown, the subcommittee believes that a duplication of research and development efforts in these fields is by no means unwarranted but is, in fact, essential in many cases.

(9) The Army is presently handicapped by inadequate authority to investigate and research certain areas of possible warfare which might be termed "exotic" or "unorthodox". These areas would include but not be limited to such concepts as chemical warfare, biological warfare, psychological warfare, decibel warfare, and microwave warfare. While the Defense Establishment is pursuing some of these programs to a point, it appears that they are generally frowned upon from the standpoint of humaneness and public relations. Testimony elicited from reliable witnesses, however, suggests that "exotic" methods might actually be much more humane than the nuclear weapons which today are taken for granted as a first-line means of defense.

RECOMMENDATIONS

The subcommittee recognizes that American processes of democratic government do not give the United States the same freedom to pursue its security objectives—especially in peacetime—with the precision, emphasis, and ruthlessness that is available to nondemocratic governments. It is clear from testimony provided by witnesses that the Army also recognizes this to be the case.

The subcommittee does believe, however, that certain things can be done to expedite the Army's research and development program and make it more effective. To this end the subcommittee recommends:

(1) That the administration review its budgetary policies at the earliest practicable time in efforts to determine if added funds for defense research and development might efficiently be put to use. National security today is as dependent upon research as Elizabethan England was dependent upon the fleet of Sir Francis Drake. If, therefore, more and better research would overburden the national budget, cuts should be made in areas less vital to basic U.S. security.

(2) That the National Security Council review high-level policies and directives in regard to the "exotic" or "unorthodox" methods of warfare and give sanction to stepped-up research programs in these areas where such action may be warranted.

(3) That the Department of Defense review its research and development contract requirements with a view toward eliminating all possible delay in this process.

(4) That the Department of Defense confer on a broad scale with industrial leaders and private contractors in efforts to restrict the output of scientific *developmental* publications which may contain information useful to totalitarian governments—insofar as such restrictions may be consistent with (*a*) traditional freedoms of information and (*b*) palpable security needs.

(5) That the Department of State and the Department of Defense immediately take steps to speed up effective liaison with outstanding scientists and science programs in other countries; that the two departments coordinate their efforts to assure greater use of foreign research and scientific talent; that maximum use of such research and talent be made within the United States.

IV. Navy

(Subcommittee No. 3)

In the course of its hearings on Navy research and development, Subcommittee No. 3 inquired into the programs, priorities, funding, and problems of research, development, test, and evaluation conducted by the Department of the Navy. It received testimony and prepared statements from a number of well qualified witnesses, including:

Vice Adm. John T. Hayward, Deputy Chief of Naval Operations, Development.

Rear Adm. Rawson Bennett, Chief of Naval Research.

Rear Adm. K. S. Masterson, Assistant Chief of Naval Operations, Development.

Rear Adm. H. A. Yeager, Antisubmarine Warfare Readiness Executive.

Rear Adm. L. D. Coates, Assistant Chief, Bureau of Aeronautics for Research and Development.

J. D. Nicolaides, Chief Engineer to Assistant Research Director for Astronautics, Bureau of Ordnance.

Dr. R. Kershner, Technical Director, Transit Program, Applied Physics Laboratory, Johns Hopkins University.

Maj. Gen. Ward H. Maris, USA (Retired), Consultant for the Defense Department in the Office of Defense Research and Engineering.

In addition, testimony and demonstrations were given by a number of supporting witnesses. Since the witnesses all testified in executive session, many details of the hearings are classified and cannot be set forth in this report.

INTRODUCTION

The hearings indicated that research and development in the Navy—and doubtless in the other armed services as well—is of necessity a very broad program, so as to make it possible to improve existing weapons and equipment for conventional warfare, in addition to putting new scientific and technical developments to prompt use in the production of new weapons, equipment, and weapon systems. For this reason, gaps and inadequacies are regarded as even greater dangers than possible duplication or programs that fail to yield immediate tangible results. Furthermore, great stress is laid on basic and supporting research as distinguished from development, test, and evaluation. The broad distinction between research and development is reflected in the Navy research and development organization and was followed in the presentation of testimony. By definition, basic and supporting research extends the range of technical possibilities, without much regard to applications. On the other hand, systems development is designed to meet specific requirements for weapons and equipment in fleet operations. Development systems are the fruit of basic and supporting research.

In addition to the general dependence on research and development in an age of rapid and accelerating technological change which it shares with the Army and the Air Force, the Navy faces certain unique requirements in planning and carrying out its research and development program:

(*a*) The Marine Corps needs light and compact equipment, and must be largely self-sufficient in carrying out many of its missions.

(*b*) In addition to meeting flight requirements like those of the Air Force, naval aircraft must operate from carriers "in a significantly different environment with respect to space, weight, launching, and recovery limitations."

(*c*) Naval missiles also must be launched from "a rolling, pitching, and moving platform" and must be generally adaptable to a seagoing environment (particularly as to space and weight).

(*d*) In view of its submarine and antisubmarine missions particularly, the Navy must engage in extensive underwater research, both basic—including hydrography, bathymetry, and oceanography—and applied (underwater weapons and detection systems).

CURRENT RESEARCH AND DEVELOPMENT PRIORITIES

The current priorities of the Navy research and development program were identified by the witnesses as follows:

(*a*) Improved *air defense*, especially in long-range detection, processing of tactical data and control of aircraft and missiles.

(*b*) Increased *amphibious* capability, especially in dispersed landings and vertical envelopment.

(*c*) Exploitation of *space technology*.

(*d*) *Basic and supporting research*, "to provide for our future capability."

CURRENT DEVELOPMENT OF NAVAL WEAPON SYSTEMS

One of the principal Navy research and development programs is intended to develop missiles of increased range and altitude, multiple target capabilities, interchangeable high-explosive and nuclear warheads and improved homing guidance systems.

Prior to the hearings, the technical press had reported on the Navy missile program as follows:

(*a*) *Surface-to-surface*

Regulus I—an air-breathing short-range missile, under development since 1948, operational since 1954, phased out of production in 1958. Reportedly installed on four conventional submarines and three cruisers. An additional nuclear submarine will soon be added to this force. In May 1959, a Regulus carried mail on a training operation out of Point Mugu, Calif. In June, another Regulus carried mail from a submarine at sea to Mayport, Fla. Regulus II, an improved version with greater speed and range, was canceled in December 1958, after completing 90 percent of its development program.

Weapon Able—an operational antisubmarine rocket, installed on destroyers and frigates.

Polaris—an intermediate-range ballistic missile, called a fleet ballistic missile, for launching from specially designed submarines. A single submarine can carry 16 missiles. Polaris can also be launched from surface ships. Nine Polaris submarines have been authorized, six of which are under construction. The Polaris system is scheduled to become operational late in 1960.

(*b*) *Surface-to-air*

Talos—a short-range operational missile designed for fleet air defense but also usable against surface targets. Installed on the U.S.S. *Galveston*, and reportedly scheduled for installation on seven other cruisers. Talos is an offshoot of the Bumblebee program, and was developed by the Applied Physics Laboratory of Johns Hopkins University.

Terrier—an operational antiaircraft missile, installed on the cruisers *Boston* and *Canberra* and the destroyer *Gyatt*. Terrier is scheduled for installation on 2 *Forrestal*-class carriers, 4 guided missile cruisers, 20 guided missile frigates, and a nuclear-powered aircraft carrier. Like Talos, it is an offshoot of the Bumblebee program. An advanced Terrier is in production and will eventually have surface-to-surface, as well as surface-to-air, capability. Tartar, a junior version of Terrier designed for use on destroyers, will soon become operational.

(*c*) *Air-to-air*

Sidewinder is the first guided missile to destroy an aircraft in combat. In September 1958, it was used by Nationalist China against Communist Chinese aircraft. Sidewinder has been operational since 1956. An advanced Sidewinder, the 1–C, is now under development.

Sparrow—a fleet air-defense weapon, Sparrow III became operational in 1958, replacing Sparrow I. Its radar guidance enables it to attack enemy aircraft from any direction, including head-on.

(*d*) *Air-to-surface*

Zuni—an unguided short-range rocket for use by aircraft against ground as well as aircraft targets. Although its development is apparently complete, Zuni is not yet operational.

Bullpup—a command-guided rocket for use by aircraft against ground targets. Operational since April 1959.

At the hearings, Navy witnesses stated that the Polaris program is on schedule, and that no serious obstacles are foreseen. The Polaris system was described as the principal Navy contribution to strategic deterrence. On June 9, 1959, while the hearings were in progress, the first Polaris submarine (the *George Washington*) was launched. In addition to the five others under construction, according to the witnesses, construction of three more will start in early fiscal year 1960.

The further development of Talos will soon culminate in a missile of greatly increased range and altitude that can be used against surface as well as air targets. Since many naval ships in the future

will carry no guns at all, their missiles must provide surface-to-surface as well as surface-to-air capabilities.

Talos was said to be very effective against aircraft at long ranges. In time, its fire-control system will be able to track missiles as well. In reply to a question, Admiral Hayward stated that fleet air-defense capabilities have kept pace with weapons of attack against surface ships. He referred specifically to the Talos.

The Sidewinder was described as the most popular, the cheapest, and the standard air-to-air missile for Navy day fighters. It is now in use by the USAF and soon will be by several NATO countries. When used by the Nationalist Chinese in the Formosa area, it had outstanding success.

The Eagle was described simply as a long-range air-to-air intercept missile. According to the technical press, it is designed for use with relatively slow launching aircraft. As Admiral Masterson said, the Navy is putting the high performance into the Eagle missile instead of the launching airplane. Admiral Hayward pointed out that very high performance interceptor aircraft have been supplemented by the surface-to-air missile, and that defensive aircraft themselves already carry antiaircraft missiles such as the Sparrow and the Sidewinder. At present, the Eagle appears to be in an early stage of development.

Corvus is an air-to-surface "standoff" missile now under development. Bullpup—a relatively short-range line-of-sight missile, described as "a weapon of limited conventional war"—is also being improved.

A number of advanced antisubmarine weapons are now in various stages of development. For example, Subroc was described as a submarine-launched missile. Its development started just last year. According to Admiral Masterson, "the submarine people think this is the best thing we have got coming along in the ASW field." New antisubmarine weapons are also under development for destroyers and aircraft. Those designed for use by aircraft were described as small, light, capable of being carried by any aircraft, helicopter, or blimp, and so versatile as to make for "logistic simplicity."

In general, new systems for antisubmarine warfare are being developed for the detection, location, classification, and kill of all types of enemy submarines "including quiet, deep-running, nuclear-powered boats." Admiral Yeager, assisted by Capt. Sheldon H. Kinney, gave the subcommittee a detailed briefing on the problems and possible new techniques of antisubmarine warfare.

Testimony was also heard on new mine countermeasures. These included a towed system for mine location and destruction, a helicopter system, and a pressure minesweeping hydrofoil.

In electronics, the Navy is developing long-range, early-warning radars capable of operating in the face of enemy countermeasures, in conjunction with effective high-speed data-processing and information-display systems.

The single-sideband technique will be exploited to facilitate communications. Major emphasis will be placed on development of the naval tactical data system.

The latter development will be designed for higher speed of operation and the ability to cope with multiple targets. The new tactical data system has been installed at the Electronics Laboratory in San Diego, and will soon be used on shipboard for its first operational evaluation.

Aircraft under development by the Navy include the A2F, a two-engine close-air-support attack aircraft, carrying a crew of two, designed to make maximum use of carrier forces for support and flexibility in both conventional and nuclear war. The A2F is said to have significantly improved radius and all-weather capability. Fleet delivery is scheduled for 1962.

Other new attack aircraft include the latest versions of the turbojets A4D2 and A3J1. The latter has already flown at a speed of Mach 2.

Another aircraft under development is the W2F, with two engines and a crew of five. Its chief advantage will be increased endurance, and it will be "completely tied to the Navy tactical data system." Like the A2F, it is scheduled for fleet delivery in 1962.

The F4H1, a very fast all-weather turbojet fighter, is scheduled for fleet introduction in late 1960.

The Navy is also developing a subsonic missile-carrying aircraft with a multitarget capability, to extend the fleet air-defense zone.

Admiral Coates described various types of aircraft used in anti-submarine warfare.

The HSS2 helicopter is equipped with all-weather instrumentation and towing or dipping sonar. The S2F3 is a large carrier-based anti-submarine airplane. Both are now flying, and are scheduled for fleet delivery in 1960.

The P3V1, an adaptation of the commercial Electra, will also be used for antisubmarine warfare. It is a large machine, capable of very high speeds, and will be based on land.

The lighter-than-air ZPG–3W has reached an advanced stage of development.

Various aircraft are being developed for use by the Marine Corps in amphibious operations.

The new mark 4 lightweight pressure suit consists of underwear, an antigravity suit when required, a torso, helmet, gloves, boots, parachute harness, and flotation garment. Weighing only 25 pounds, it is said to be mobile and comfortable and especially useful for arctic survival. A fighter squadron equipped with the mark 4 suit has been aboard the U.S.S. *Ranger* since December 1958. Ten additional squadrons are being outfitted. NASA is testing the mark 4 suit, slightly modified, for Project Mercury.

The Navy nuclear-reactor program was briefly described. Under the fiscal year 1960 program, five specific nuclear reactors are being developed for eventual installation on naval combatant ships.

Considerable testimony was given on the development of a satellite navigation system. The first test vehicle is scheduled for launching late this year. It will be fired from a Thor-Able at Cape Canaveral. Tracking stations will be located at "the extremes of the country." Three more satellite launchings are scheduled to be made, in all, before the creation of an operational system. Navigation satellites are expected to stay in orbit for years, and to transmit continuously.

Research on the satellite navigation system was done at the Applied Physics Laboratory of Johns Hopkins University, which devised a method of listening to the satellite and so determining the distance from the satellite to the listening ship, submarine, or aircraft. The same method can also be used to track a satellite. For that purpose, however, it is necessary to know the force of gravity at pertinent points in space, and hence the mass distribution of the earth.

Ad niral Masterson testified that, in his opinion, no other nation is nore advanced than the United States in the develop nent of navigagion satellites.

CURRENT NAVY RESEARCH

General

As was said above, the Navy believes in conducting research and development over a wide range and in depth, with a considerable program devoted to basic research. In support of this belief, Admiral Bennett cited many instances in which basic research has led to major military applications: For example, nuclear research leading to the *Nautilus* powerplant; research on the polymerization of nitrogenous compounds leading to solid fuel rockets such as Polaris; oceanographic studies which facilitated construction of the DEW line and made possible the transpolar submarine voyage of the *Nautilus;* upper atmosphere research preliminary to the discovery and analysis of the Van All n radiation belts; and laboratory experiments on high velocity, highly heated gases, which have facilitated the solution of reentry problems.

Examples such as the foregoing should always be borne in mind, since it is not necessarily obvious at the time that a given program of basic research will relate to any specific naval or military problem. Furthermore, as Admiral Bennett pointed out, "it may take years for a basic investigation to pay off."

Admiral Bennett described the practical applications of recent basic research conducted at the Naval Research Laboratory. The theoretical analysis of submarines has enabled the Navy to stiffen the frames of submarines so as to reduce weight and increase useful volume. A cleanser-solvent mixture has been developed for removing water and oil from electrical and other equipment (often a serious problem, especially aboard submarines). Research on radio astronomy has led to new and improved devices for radio navigation. In medicine, useful work has been done on bone grafting, allergens, blood transfusions and cancer therapy.

A major breakthrough achieved by the Naval Research Laboratory was announced in early August of 1959. This was Project Tepee, a long-range missile warning system. Tepee makes use of ionospheric backscatter from high-frequency radar transmitters. It has already detected missile launchings and nuclear explosions over intercontinental distances. Although Tepee is still in the research stage, its further development is said to be mainly a matter of improving the quantity and quality of the information it obtains.

In collaboration with a committee of the National Academy of Sciences and the National Research Council, the Navy has recently laid out a 10-year national program of oceanography. The Navy has also taken the lead in forming an interdepartmental oceanographic committee. Admiral Bennett pointed out some of the naval applications of oceanography, as follows:

> Oceanography is a broad area with many factors affecting our problems, the temperature structure of the water, the ocean bottom, the ocean currents, and the waves at the surface. Some of these items affect the transmission of sound. Currents, including the countercurrents below major ocean currents (discovered in 1958) affect the move-

ment of ships. Research on surface wave condition prediction can lead to better routing of ships, even merchant ships.

Other research at the Naval Research Laboratory concerns flight characteristics at high temperatures and altitudes (including ablation, stress, and creep). Experiments in high-altitude physics are being made with Skyhook balloons, but are ultimately to be made with satellites. For example, photographs of the sun were recently taken from a Skyhook balloon with a 12-inch telescope at over 80,000 feet. At that altitude, atmospheric distortion was almost eliminated, and new knowledge was gained as to solar effects on weather and communications.

In solid-state physics, research has been done in the past on the conductivity of such materials as indium antimonide, magnesium plumbide and gallium arsenide. This work has led to significant commercial applications, notably transistors.

Weather research is another aspect of the Navy program. Admiral Bennett described Project Hugo—a rocket observation system for photographing large weather areas.

Applied research is also carried out by the Office of Naval Research as well as by the Navy technical bureaus (such as the Bureau of Ships). Some of the work in metallurgy, for example, is aimed at the development of high-strength alloys which will resist heat and radiation. Other applied research is being conducted in aerodynamics, hydrodynamics and hydromechanics (e.g., supercavitating propellers), data processing, materials and component development, and operational analysis and system studies.

Admiral Bennett concluded his review of current Navy research by emphasizing that all of the efforts he had described are part of a single coordinated program.

The foreign naval research program

The Navy has responsibility for two foreign research programs: (1) Certain projects under the mutual weapons development program, administered by the Department of Defense and consisting of classified research contracts; and (2) the Navy's own, unclassified foreign contract research program, administered by the Office of Naval Research.

The mutual weapons development program (MWDP) was established by the Mutual Security Act of 1953. Funds for the program come from foreign aid appropriations. Bilateral agreements were made, initially, with Belgium, France, Italy, the Netherlands, Norway, and the United Kingdom, and later with Denmark, Turkey, and West Germany.

There are three types of MWDP project: (1) Projects for research on, or development of, specific weapons or equipment; (2) research centers; and (3) data exchange agreements. Each project is monitored by one of the military departments.

At present, there are three MWDP research centers: The Aerodynamics Training Center near Brussels, Belgium; the Air Defense Technical Center at The Hague, the Netherlands; and the Antisubmarine Warfare Research Center (Oceanographic Institute) at La Spezia in Italy. Of these, the Navy is responsible for the La Spezia Center only.

Admiral Hayward described the MWDP as follows:

> The mutual weapons development program was established by a special provision of the Mutual Security Act of 1953 with the primary objective of increasing the defensive capability of our allies and improving our mutual security through the provision of U.S. financial and technical assistance to selected, highly promising projects for weapons of advanced design in their research and development programs. Support of these projects is shared between the United States and the other nations on approximately a 50–50 basis.
>
> The MWDP is administered by the Director of Defense Research and Engineering in coordination with the Assistant Secretary of Defense (International Security Affairs). The fieldwork is to a large degree decentralized and is carried on through the Mutual Weapons Development Team located in Paris. Headed by General Larkin, this team consists of a director and representatives of our three military departments.
>
> The missions of the three military department representatives are similar in that they have the responsibility for monitoring, reviewing, and commenting on MWDP projects proposed by the allies of interest to their respective departments.
>
> In the initial increment of the proposed fiscal year 1960 MWDP, the U.S. Navy will have the responsibility for monitoring 19 projects.

The SACLANT Oceanographic Institute was commissioned on May 2, 1959. It will be funded by the United States, under the MWDP, for the first 2 years of operation, at an estimated cost of $2,750,000. Facilities contributed by Italy would cost an estimated $1 million. Participating countries are Canada, Denmark, France, Germany, Italy, the Netherlands, Norway, the United Kingdom, and the United States. According to Admiral Hayward:

> The mission of the center is to provide technical advice and assistance to SACLANT and other NATO commanders in the field of ASW. To this end the center has been directed to conduct operational research and analysis, oceanographic studies and research and limited development in the area of submarine detection, identification and classification. * * * By agreement with the Government of Italy, that country is to furnish the facilities and certain services while the United States will provide supporting funds for the initial period. * * * An international subsidiary of Raytheon Corp. is now operating the center on a nonprofit basis, furnishing management and administrative services. The Scientific Director is a U.S. scientist, Dr. Boothe. The U.S. Navy is the acting agent of the Secretary of Defense for purposes of monitoring the contract.

In answer to a question, Admiral Hayward stated that the La Spezia center will cost less than an equivalent laboratory in the United States.

In addition to the MWDP, the Navy (like the other military departments) has unclassified research contracts directly with foreign individuals and institutions. This program, known as the Navy European Research Contracts Program (NERCP), is funded with money appropriated to the Navy Department for research and development. Its purpose is to utilize unique European scientific and engineering capabilities which are needed by the Navy.

As of July 1958 the Navy had 27 unclassified foreign research contracts, including spray momentum studies and research and development in gyro design. Admiral Hayward indicated that the program might be extended to non-European areas.

Navy monitoring of foreign research projects under both MWDP and NERCP is done largely through the Office of Naval Research in London. As Admiral Hayward stated:

> A U.S. Navy agency closely connected with the MWDP is the Office of Naval Research—London. The Office of Naval Research—London is the only U.S. Government agency abroad that functions primarily for scientific liaison. Activities of this office encompass fundamental research and extend into the area of technological development as related to naval equipment and operation, and provide some modest support for actual research and development in European laboratories.
>
> Its primary role—interchange of scientific information between the United States and European countries—is effected by personal contacts and attendance at international symposia, ad hoc meetings, and group discussions. The ONR—London scientific staff incorporates selected technical information into formal reports such as the European scientific notes, technical reports, technical memoranda, and letters, which are the main media for transmission of scientific information.
>
> This office also plays an important role in the mutual weapons development program and the Navy European research contracts program. Assigned responsibility for monitoring projects of MWDP, the office recommends technical assistance, documents, and exchange of visits among technical personnel. Although closely coordinated with the Army and Air Force European research contracting offices, NERCP relies primarily on ONR—London for a firsthand and accurate appraisal of European scientific capabilities.

NAVY RESEARCH AND DEVELOPMENT FUNDS

For fiscal 1960, the total Navy budget is $11,370,000,000. The budget for research and development is $970,920,000. Of this amount, only $522 million will be provided for basic and supporting research.

Admiral Hayward was asked whether the Navy has received its proportionate share over the past few years of the increase in funds appropriated to the Department of Defense for research and development. His reply was: "Not for basic research and development."

In support of this statement, Admiral Hayward gave the following figures:

Basic and supporting research

[In millions of dollars]

1951	441	1955	441	1958	458
1952	498	1956	440	1959	521
1953	543	1957	447	1960	522
1954	450				

According to both Admiral Hayward and Admiral Bennett, there has been essentially "level funding" over the past few years of basic and supporting Navy research and development. The increases which have occurred have barely made up for inflation, although other funds have been added for separately identifiable items of *applied* research and development such as Polaris.

In reply to a question, Admiral Hayward said that he had asked for approximately $146.4 million more than the amount shown in the fiscal 1960 budget—mostly for basic and supporting research. He added that, in his opinion, "about 10 percent of the Navy budget should be in R. & D." (This would require an increase of more than $150 million in research and development funds).

PROBLEMS OF NAVY RESEARCH AND DEVELOPMENT

Research versus development

As the foregoing discussion of the Navy budget indicates, one of the principal problems of Navy research and development is the relative neglect of basic and supporting research (as contrasted with applied research, development, test and evaluation). In this connection, Admiral Bennett commented:

> Since we are essentially doing approximately the same amount of research, never mind whether it is up or down a little bit, with the expansion, the growth in science and technology, we are in danger of being trapped a few years from now and having to even stop a weapons system development because not even the basic work has been done. It is just that the times are such that you just have to do more research to be able to do the development.

Components versus systems

Navy witnesses emphasized that component development has suffered because of overemphasis on weapon systems. Admiral Hayward characterized component development, together with basic research, as the "seed corn" of the research and development program. "Everyone has gotten carried away with the weapons systems business," he said.

> We have attempted to put systems together before we have done our homework on the components. We try to invent on schedule, whereas if we put our money in the components, then when we are ready to put a system together, we know what the state of the art is in the components. I feel we could put our systems together more rapidly and get them into operation sooner [if we put more emphasis on components and less on systems].

For example, timely research on bearings and gyro mechanisms for stable platforms would have increased the present accuracy of our ballistic missiles; and component research on vital parts for solid-fuel rockets would have added to the capabilities of Polaris and Minuteman. Component work benefits many systems, though not directed to any. Thus Polaris, a Navy system, benefited from the guidance mechanism of Thor, an Air Force system; and Minuteman, an Air Force system, will benefit in turn from the guidance mechanism of Polaris. A Navy computer (Whirlwind) served as the basis for the SAGE (air defense) computer system. The component approach was necessarily followed in the Manhattan project because, at the time, it would have been impossible for anyone to propose a system.

Admiral Hayward stated that his remarks in this regard were not confined to the Navy, but that he believed greater stress should be placed on component development, as distinguished from weapon systems, by all U.S. agencies.

Gaps

Testimony indicated that the major gaps in Navy research and development are basic and supporting research, component development and electronics in general.

The Navy Department later submitted a list showing areas of basic research that are regarded as not adequately funded, as follows:

Areas of basic research that are not adequately funded in the fiscal year 1960 budget appropriation "Research, development, test, and evaluation, Navy"

(In thousands of dollars)

Scientific field	*Amount*
Astronomy and astrophysics	$1,596
Biology and biological sciences	775
Chemistry	30
Earth physics	50
Electronics	[1] 800
Geography—Arctic research	250
Mechanics	925
Medical sciences	475
Material sciences	[1] 975
Mathematics	325
Meteorology	50
Oceanography	1,075
Physics	[1] 3,135
Psychology	190
Astronautics and aeronautical engineering	496
Electrical and electronics engineering	670
Human engineering and ergonomics	45
Statistics	250
Logistics	250
Personnel management	210
Total	[2] 12,572

[1] Includes unfunded areas in solid-state physics, such as: Investigations in physical electronics, alloying behavior of metals, and high temperature properties of solids. Additional funds invested now for basic research in solid state physics would shorten the delivery date, improve the end product, and greatly decrease the development costs of equipments for fleet use.

[2] Included in the unfunded requests of $150,800,000 listed on p. 35.

FINDINGS

(*a*) In addition to a general dependence on research and development, which it shares with the Army and the Air Force, the Navy has unique research and development requirements resulting from

carrier operation of aircraft, shipboard use of missiles, Marine Corps needs and submarine and antisubmarine operations.

(*b*) Research and development funds constitute only 8.5 percent of the total Navy budget for fiscal 1960. An increase of more than $150 million would be needed to raise this percentage to 10 or so, as recommended by Admiral Hayward. (Comparable percentages in the Army and the Air Force are 10 or more.)

(*c*) There has been essentially level funding over the past few years of basic and supporting Navy research and development, in spite of inflation and the increasing rate of technological change. The Navy budget for basic and supporting research—as distinguished from applied development, test and evaluation—is thus becoming relatively lower, year by year. Witnesses testified that the Navy program of basic and supporting research has not received its proportionate share over the past few years of increases in Defense Department funds.

(*d*) Missiles of all types and antisubmarine weapons and equipment are under vigorous development by the Navy.

(*e*) Fleet air defense has kept pace with weapons of attack against surface ships by shifting to greater reliance on missiles. This is in marked contrast to continental air defense, for which increasingly big and fast fighter aircraft have been built, to cope with the improving performance of attack missiles and aircraft. The use of bigger and faster fighter aircraft for fleet air defense is limited by handling and operating requirements aboard carriers and by fuel requirements.

(*f*) Fleet air defense is given a top priority in the Navy research and development program.

(*g*) Research and development in the field of electronics (for both detection and communications) appears to be making good progress, but at too low a level of support. Data-processing systems are receiving major emphasis.

(*h*) Five specific nuclear reactors are under development by the Navy.

(*i*) The Navy has derived substantial benefit from its foreign research programs.

(*j*) According to Navy witnesses, the major gaps in the Navy research and development program are basic and supporting research, component development, and electronics.

(*k*) The ASW standoff problem may require a prohibition against submerged foreign submarines within accurate missile-launching distance (perhaps 200 miles at the present time) of the U.S. coastline.

RECOMMENDATIONS

(*a*) That Navy funds for research, development, test and evaluation be raised to 10 percent or more of the total Navy budget, and that half or more of such funds be provided for basic and supporting research.

(*b*) Regardless of budgetary levels, that greater emphasis be placed on basic and supporting research, component development, electronics, and attack aircraft (especially aircraft-missile attack systems).

(*c*) That the Navy's foreign contract research program be moderately increased in budget, and extended to additional countries (including non-European countries).

(*d*) That the problem of continental defense against submarine-launched missiles receive further study, with special attention to the possible prohibition of submerged foreign submarines off U.S. coasts within a distance of at least 200 miles.

V. Air Force

(Subcommittee No. 4)

INTRODUCTION

As part of its intensive program to gather information that would help to determine the scope of its responsibilities, the Committee on Science and Astronautics directed its Subcommittee No. 4 to conduct hearings on the extent of research and development presently being conducted by the U.S. Air Force.

Evaluation, preliminary to the hearings, which were held on June 11 and 12, 1959, revealed that the vast scope of Air Force research and development programs which, in dollars, far exceeded those of the other military services, coupled with the limited time available to the subcommittee, prohibited a definitive investigation.

It was therefore decided that the subcommittee would restrict itself to matters of a general nature such as the philosophy, management, organization, and status of personnel requirements.

On the first day of hearings, June 11, the subcommittee heard testimony from Dr. Joseph V. Charyk, Assistant Secretary of the Air Force for Research and Development, and Lt. Gen. R. C. Wilson, USAF, Deputy Chief of Staff for Development. On June 12, Lt. Gen. Bernard A. Schriever, Commander, Air Research and Development Command, and his staff made an extensive presentation to the subcommittee.

HISTORICAL BACKGROUND OF AIR FORCE RESEARCH AND DEVELOPMENT

Scientific air research and development, as a recognizable effort distinct from operational activities, did not really take form until shortly after World War I, and, as part of the U.S. Army, the Air Corps research functions were necessarily governed by Army philosophy and methods.

First, the research effort was small in every respect, and accomplished principally at McCook Field at Dayton, Ohio. Practically all development was done within the Air Corps, and finished items were supplied by industry.

During the 1920's and 1930's the technological progress of aviation advanced at a relatively high rate, with industrial and commercial requirements providing an indispensable stimulus, and from which the Army Air Corps was able, within its restricted economic limits, to take advantage. Despite meager support through the years between wars, Air Corps research was able to reap the technical benefits produced by the increasing industrial development that took place in every part of our industrial economy.

The Air Corps realized that if these benefits were to obtain fully to our airpower, the old methods of conducting air research and development would have to be drastically changed. Faced with an increasing technological complexity and with the threat of another war, the Air

Corps began to draw upon the scientific resources accumulating in commercial and academic organizations, realizing that the true nature of airpower demanded the technical resources of the entire Nation.

World War II, of course, provided a tremendous impetus to research and development that has led to the space capability presently within reach.

Now, under the direction and guidance of the Air Force, industry and universities provide the major portion of the air research and development products that maintain our acknowledged scientific leadership on a broad scale.

Organizationally, the control of research and development in the Air Corps, during its years as part of the Army, was vested in the Materiel Command, headquartered at Wright Patterson Air Force Base at Dayton, Ohio. In many areas, procurement factors often outweighed research considerations, a situation that gradually became unacceptable. However, in 1949, following the establishment of the Air Force as a separate service, an exhaustive study conducted by Dr. Louis A. Ridenour, at the direction of Gen. Hoyt Vandenberg, led to the creation in 1950 of the Air Research and Development Command, which would perform all research and development for the Air Force. Under the findings of the same study, the posts of Deputy Chief of Staff for Development and of Chief Scientist were established. Later, in 1955, the office of Assistant Secretary of the Air Force for Research and Development came into being.

MANAGEMENT OF AIR FORCE RESEARCH AND DEVELOPMENT

Management of Air Force research and development is accomplished at the command level, with ARDC responsible for the major portion. As it was previously pointed out, the concepts of research management have changed in the Air Force to meet the operational requirements created by an ever expanding technology and the emergence of a global mission.

Through ARDC and its laboratories established in nine centers located in all parts of the country, research conducted by industry and academic institutions is directed and the products evaluated.

There exists at command level a uniting of procurement and research functions that gives rise to the weapons systems evaluation offices. This arrangement maintains a constant awareness within the many programs underway of the needs of the customers—the Air Force operational units.

While ARDC provides the direct, day-to-day management of Air Force research programs, the overall broad management functions are accomplished at Air Force Headquarters at the Pentagon by three organizations: (1) The Deputy Chief of Staff for Development, (2) Scientific Advisory Board, and (3) Office of the Assistant Secretary of the Air Force for Research and Development.

It is in these three groups that the entire spectrum of Air Force Research and Development is coordinated and integrated with the policies and objectives involved in accomplishing the basic Air Force mission, in consonance with the overall responsibilities of the Department of Defense.

In quantitative terms, the Air Force manages the largest single research and development effort in the world. It directly involves

approximately 54,000 people and billions of dollars in capital investment. The present total program amounts to $2.7 billion, the preponderant share being devoted to development. This does not measure the qualitative importance of the research effort, since economics most significantly influences the translation, in dollars, of research into hardware. It is statistics such as these that give dimensions to the management job being accomplished by the Air Force.

ORGANIZATION OF AIR FORCE RESEARCH AND DEVELOPMENT

Air Force research and development is divided into four major program areas. They are command operations, the research program, advanced development, and operational development.

The first is concerned with the operating and maintenance of the research and development agencies—in other words, the research overhead, which in fiscal year 1960 amounts to $355 million and includes civilian salaries, purchased equipment, rents, fuels, utilities, travel, and so forth.

The second includes thousands of operating contracts with commercial and academic institutions. These will cost about $305 million with $35 million for basic research, and $270 million for applied research.

The third, advanced development program, is concerned with those activities that are presently being executed to meet future operational requirements, such as DynaSoar and Project Pluto, and has been allocated $22 million in the present budget.

The fourth area, operational development, is concerned with system and equipment designed for operations units. Funding is provided both by research and development and procurement appropriations totaling $1,841 million, with research and development money equaling $278 million and procurement $1,563 million.

The Air Force research effort must be continuously guided by the present and future needs of the customer—the operational forces. Policy must be laid down in consonance with the Air Force mission. Such policies and guidelines are established by several staff boards concerned with specific general areas of interest which review the progress of research and development programs in terms of operational requirements.

The Weapons Board reviews the projects in the operational development program and advanced development program from the point of view of the current forces. The Force Estimates Board, on the other hand, looks at the advanced development program since it is concerned with future requirements and estimates. And the Budget Advisory Board reviews command operations to make sure that overhead costs are reasonably comparative to the rest of the Air Force.

The opinions and judgments of these boards are fed to the Air Force Council, which is composed of all the Deputy Chiefs of Staff, which in turn renders its recommendations to the Chief of Staff.

AIR RESEARCH AND DEVELOPMENT COMMAND

This organization has the responsibility for performing the major portion of the overall research and development programs currently underway in the Air Force. By regulation, ARDC is directed to

(1) attain and maintain qualitative superiority of aeronautical equipment and to conduct or supervise scientific and technical studies required to accomplish the Air Force mission; (2) seek new basic knowledge for developing improved aeronautical equipment, material, weapons, and techniques; (3) develop and recommend new and improved devices and systems for conducting and supporting operational missions, including complete weapon systems, techniques, and procedures.

ARDC, whose headquarters are located at Andrews Field, Md., has three major operating elements: (1) The Air Force Ballistic Missile Division, located in Los Angeles; (2) the Air Defense Systems Integration Division, located in Boston; and (3) the Directorate of Systems Management located at Wright-Patterson Field in Dayton, Ohio.

Subordinate organizations of ARDC Headquarters are:

The Air Force Office of Scientific Research; the European Office of Research; the Armed Services Technical Information Agency; and the Air Research and Development Command centers. In the last are included: the Wright Air Development Center; the Air Force Cambridge Research Center; the Rome Air Development Center; the Arnold Engineering Development Center; the Air Force Special Weapons Center; the Air Force Flight Test Center; the Air Proving Ground Center; the Air Force Missile Development Center; and the Air Force Missile Test Center.

To give dimension to ARDC, there are more than 44,000 military and civilian personnel in the command, with a capital investment of almost $1.8 billion, and a current budget responsibility for $2.6 billion.

AREAS OF SPECIAL SUBCOMMITTEE INTEREST

Leadtime

Since the end of World War II the U.S.S.R. has shown a remarkable capacity to bring swiftly to a hardware state many complex scientific systems, exemplified by their nuclear and thermonuclear weapons and advanced type aircraft. The Soviet leaders, by taking advantage of their unlimited authority, seem to have been able to reduce dramatically the customary leadtime between concept and reality—a factor that has had in recent years a significant effect upon relative international military postures. It is this idea of leadtime that will be important in determining whether or not this country can maintain a military power generally superior to that of the U.S.S.R.

The subcommittee's interest stems from the fact that the country gains little by excelling in scientific research if an excessively long time is required to translate scientific accomplishment into operational hardware. This was emphasized very strongly in the recent Rockefeller report, which stated:

> A nation can achieve a basic advantage if it is able either to develop or to produce weapons more rapidly than its opponents. One of the major weaknesses in our strategic posture has been our inordinately long leadtime.

The Air Force has developed two basic, governing philosophies of research and development that have been successful in helping to reduce drastically the timelag between conception and realization which has hampered in the past our efforts to match the rate of Soviet technological progress.

The first relates to specific weapons systems and to the status of the component elements. By weighing knowledge against possibility of achievement, a decision to proceed with the development of a given system can be based on a margin of tolerance well within the limits of calculated risk, even though at the time of decision, none of the essential component parts of the system actually exist. A case in point is our current ICBM program which was undertaken long before we had a proper heat resisting nose cone, or a small high-yield warhead, or a guidance system. Prior evaluation determined that these items could be made available at the proper stage of system development when they would be needed.

Parenthetically, if the Air Force had waited until all the necessary component parts had been produced before beginning its ICBM program, our national military posture would now be hopelessly inadequate to maintain our position as the most powerful force for peace in the free world.

The second philosophy actually concerns the methods by which the first can be applied in the most advantageous manner. It is what the Air Force terms "concurrency of development." It involves all those factors that are directly related to a given weapons system that must be developed concurrently along with the development of the whole system, and must be ready for incorporation into its proper place at the proper time.

Results have proved out the validity of these philosophies, demonstrated by the fact that the United States has produced a workable ICBM capability that had its beginnings back in 1954.

Personnel requirements

During both of the subcommittee's hearings, witnesses were closely queried about factors affecting the Air Force research and development programs, particularly with regard to obtaining qualified people on all levels of competence in sufficient quantity.

As the manager rather than the performer of its research programs, it is essential that the Air Force have the capability to provide the proper guidance and direction to the contractors and to be able to evaluate precisely the research products. This applies not only to whole systems but also to the "nuts and bolts" of the subsystems as well. The imperative need for talent on all levels is underscored by the vital strategic responsibility borne by the Air Force.

All witnesses agreed that the Air Force does not have sufficient scientific and technical personnel, and is faced yearly with the loss of valuable personnel to commercial firms through inducements of salaries much higher than the Air Force can pay.

For instance, each year ARDC gets a rather large number of ROTC graduates with engineering degrees. The Air Force would like as many as possible of these men to take regular commissions and stay in the service. However, the record shows that about 90 percent of these young men leave to take positions in private industry after serving their required time. One witness said:

> We are having trouble inhouse because as soon as an officer or civilian within the Air Force acquires a considerable degree of knowledge, he is under tremendous pressure from industry to leave the service.
>
> So far we haven't had a general exodus. We don't have enough of these people, and I anticipate growing problems

in keeping these people with us simply because of pressure. money pressure.

The subcommittee also sought to determine to what degree the customary military rotation policies were influencing the decisions of people to leave the service. This could be a critical factor in view of the fact that many highly qualified people remain in the service regardless of salary differentials with industry because of their deep interest in the work they are doing. Any procedure that might remove them from their jobs could result in their decision to leave the Air Force in order to grasp an opportunity to pursue their main vocational desires.

It develops that the Air Force has recognized the effect of rotation upon morale in specialized areas such as R. & D., and endeavors to maintain officers' assignments in their particular field.

However, the subcommittee did not receive any evidence that this was a general policy but rather was "special."

It should be pointed out that within the Air Force R. & D. programs there are many dedicated, highly motivated officers and civilians who are not open to proselytizing by industry, who believe that they are making valuable contributions to the security of the United States. Nevertheless, it would appear that (*a*) the Air Force does not have as many qualified research people as is believed necessary, and (*b*) as future Air Force programs increase in number and complexity, this disparity between available inhouse talent and the number required could grow to serious proportions.

International scientific cooperation

The exchange of scientific information among nations of the free world is a subject of considerable concern to the subcommittee. It is generally acknowledged that in the broad area of basic research, European scientists are traditionally better oriented to this type of investigation than are our own. Further, it is within the field of interest of the Air Force to draw upon foreign programs of research wherever possible that would contribute substantially to our own efforts. This activity is being pursued vigorously by ARDC through its European Office and through Air Force liaison with the mutual weapons development program in connection with the NATO countries. The European office of ARDC, has surveyed the European countries for the best possible basic research capabilities, often discovering outstanding people and projects that were known only within a very limited area. Over the past 10 years, the Air Force has negotiated many contracts with foreign universities and individual scientists who were engaged in research directly related to scientific areas in which information was needed. These agreements are not limited to the NATO countries but include all countries outside the Iron Curtain.

It should be pointed out that generally the Air Force does not take the initiative in placing these contracts, which are all in unclassified areas. Instead, foreign researchers are encouraged to submit proposals for investigating certain basic aspects in their respective fields. These proposals are screened by ARDC and those accepted are usually funded either by the Office of Scientific Research or by one of ARDC's centers. In other words, ARDC does not offer research contracts to

foreign institutions or scientists, but rather only acts upon the requests for support of projects received from overseas sources.

The most attractive features, of course, of such foreign research contracts are that they (*a*) provide substantial support to scientific organizations of great importance to the welfare of the European Community, and (*b*) because of the present price levels existing in Europe today, the expenditure of relatively small amounts of money can produce significant scientific results.

It is evident that such activities as conducted by ARDC European office and by the mutual weapon development program will establish a rapport between the scientific community of Europe and the United States that will have far-reaching effect, particularly with regard to the imminent ventures into space. These foreign countries that do not have the material resources to conduct actively space exploration projects, nonetheless can and do participate with the United States in source efforts presently being conducted by NASA. The subcommittee need only point to the great scientific breakthroughs of recent years that have come out of the European scientific community—nuclear fission that has made available the limitless energy of atomic power, and the jet engine that has already revolutionized the aviation industry. Such achievements have largely come to fruition through the great economic and industrial resources of the United States.

CONCLUSION

There is no doubt that the power of the Air Force, as the most potent defense against the aggressive ambitions of the Soviet Union is based on the ability of its air research and development effort to take full and quick advantage of scientific progress. It seems abundantly clear to the subcommittee that this ability must continue to have as its foundation sufficient resources and support, dynamic management and organization, and, lastly, trained and qualified people at all levels. Leadtime between concept and reality must continue to be compressed and every possible technique to reduce the time lag must be explored. Means to reduce the loss of needed scientifically qualified people from the Air Force to industry must be sought vigorously. Important pools of scientific information and knowledge accumulating elsewhere in the world must be tapped and made available as a resource of the free world.

○